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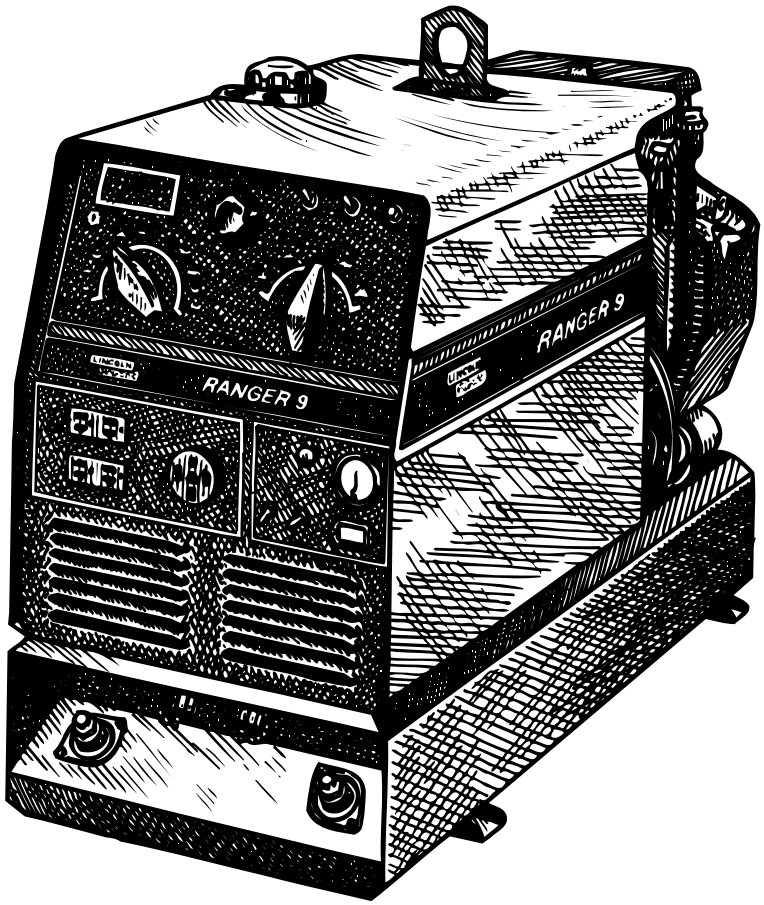
SVM 110-A
January, 1996

RANGER™ 9

For use with machine code numbers **9975** and **9976**



Safety Depends on You

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

SERVICE MANUAL

LINCOLN® ELECTRIC

World's Leader in Welding and Cutting Products

Premier Manufacturer of Industrial Motors

Sales and Service through subsidiaries and Distributors Worldwide
22801 St. Clair Ave. Cleveland, Ohio 44117-1199 U.S.A. Tel. (216) 481-8100

SAFETY

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

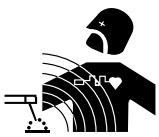
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

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ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- **Semiautomatic DC Constant Voltage (Wire) Welder.**
- **DC Manual (Stick) Welder.**
- **AC Welder with Reduced Voltage Control.**

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases.When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.d. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer’s safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.e. Also see item 1.b.

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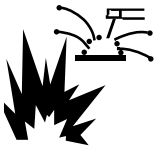


WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to “Safety in Welding and Cutting” (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

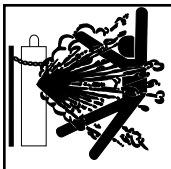
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been “cleaned”. For information, purchase “Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances”, AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically “hot” parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, “Precautions for Safe Handling of Compressed Gases in Cylinders,” available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.

FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer’s recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer’s recommendations.

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PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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INSTALLATION

TECHNICAL SPECIFICATIONS - RANGER 9

INPUT - GASOLINE ENGINE

Manufacturer	Description	Speed	Displacement	Ignition	Capacities
Onan P218®	2 cyl., 4 cycle air-cooled gasoline 18 HP @ 3600 RPM	3500 RPM Full load 3700 RPM High idle 2200 RPM Low idle	47.7 cu. in. (782 cc)	Electric Manual choke	Fuel: 9 gal. (34 l) Oil: 1.8 qt. (1.7 l)

RATED OUTPUT - WELDER

Duty Cycle	Amps	Volts at Rated Amperes
100% Duty Cycle	250 AC Constant Current	25
100% Duty Cycle	250 DC Constant Current	25
100% Duty Cycle	250 DC Constant Voltage	25

OUTPUT - WELDER AND GENERATOR

Welding Ranges	Max. Open Circuit Voltage	Auxiliary Power	Auxiliary Power for Wire Feeders
40 - 250 Amps	80 Volts RMS @ 3700 RPM	9000 Continuous Watts 80 Amps @ 115 V 40 Amps @ 230 V	42V, 60 Hz, 8 Amps 115V, 60 Hz, 8 Amps

PHYSICAL DIMENSIONS

Height	Width	Depth	Weight
With Onan Engine: 30.3 in. 770 mm	19.2 in. 485 mm	42.3 in. 1074 mm	562 lb. 255 kg

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Read this entire installation section before you start installation.

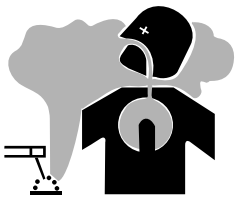
SAFETY PRECAUTIONS

⚠ WARNING

Do not attempt to use this equipment until you have thoroughly read all the operation and maintenance manuals supplied with your machine. They include important safety precautions; detailed engine starting, operating, and maintenance instructions; and parts lists.

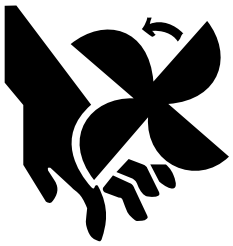
ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.



ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust to the outside.
- Do not stack anything on or near the engine.



MOVING PARTS can injure.

- Do not operate this equipment with any of its doors open or guards off.
- Stop the engine before servicing it.
- Keep away from moving parts.

Only qualified personnel should install, use, or service this equipment.

LOCATION AND VENTILATION

Whenever you use the RANGER 9, be sure that clean cooling air can flow through the machine's gasoline engine and the machine case. Avoid dusty, dirty areas. Also, keep the machine away from heat sources. Do not place the back end of the generator anywhere near hot engine exhaust from another machine. And of course, make sure that engine exhaust is ventilated to an open, outside area.

The RANGER 9 may be used outdoors. Do not set the machine in puddles or otherwise submerge it in water. Such practices pose safety hazards and cause improper operation and corrosion of parts.

Always operate the RANGER 9 with the case roof on and all machine components completely assembled. This will protect you from the dangers of moving parts, hot metal surfaces, and live electrical devices.

⚠ WARNING

Damage to the fuel tank may cause fire or explosion. Do not drill holes in the RANGER 9 base or weld to the RANGER 9 base.

STORING

1. Store the machine in a cool, dry place when it's not in use. Protect it from dust and dirt. Keep it where it can't be accidentally damaged from construction activities, moving vehicles, and other hazards.
2. If you will be storing the machine for over 30 days, you should drain the fuel to protect fuel system and carburetor parts from gum deposits. Empty all fuel from the tank and run the engine until it stops from lack of fuel. If you prefer, you can treat the gasoline with a stabilizer to prevent deterioration rather than drain the system. Follow the stabilizer manufacturer's instructions. Add the correct amount of stabilizer for the size of the RANGER 9 fuel tank. Fill the tank with clean, fresh gasoline. Run the engine for two to three minutes to circulate the stabilizer through the carburetor.
3. While the engine is still warm, drain the oil and refill with fresh 10W30 oil. Change the oil filter.
4. Remove the spark plugs and add one to two tablespoons of engine oil or rust inhibitor into each cylinder. Replace the spark plugs but do not connect the plug leads. Crank the engine two or three times to distribute the oil.
5. Clean any dirt and debris from the cylinder and cylinder head fins and other exterior surfaces.
6. Store in a clean, dry area.

INSTALLATION

STACKING

RANGER 9 machines CANNOT be stacked.

TILTING

Place the machine on a secure, level surface whenever you use it or store it. Any surfaces you place it on other than the ground must be firm, non-skid, and structurally sound.

The gasoline engine is designed to run in a level position for best performance. It can operate at an angle, but this should never be more than 15 degrees in any direction. If you do operate it at a slight angle, be sure to check the oil regularly and keep the oil level at the FULL mark as it would be in its normal level condition. Also, fuel capacity will be a little less at an angle.

LIFTING

The RANGER 9 weighs 562 lbs/255 kg. A lift bail is mounted to the generator stator frame and should always be used when lifting the machine.

HIGH ALTITUDE OPERATION

If you operate the RANGER 9 at altitudes above 5000 feet, you should install a carburetor jet designed for high altitude operation. This will result in better fuel economy, cleaner exhaust, and longer spark plug life. It won't give increased power. Power is decreased at higher altitudes. Contact the engine manufacturer to obtain these high altitude jet kits (Onan kit part number 146-0458).

⚠ CAUTION

Do not operate a RANGER 9 with a high altitude jet installed at altitudes below 5000 feet. The engine will run too lean and operate at higher engine temperatures, which can shorten engine life.

PRE-OPERATION ENGINE SERVICE

Read and understand the information about the gasoline engine in the ***Operation*** and ***Maintenance*** sections of this manual before you operate the RANGER 9.

⚠ WARNING

- Keep hands away from the engine muffler or HOT engine parts.
- Stop the engine when fueling.
- Do not smoke when fueling.
- Remove the fuel cap slowly to release pressure.
- Do not overfill the fuel tank.
- Wipe up spilled fuel and allow the fumes to clear before starting the engine.
- Keep sparks and flame away from the fuel tank.

OIL

The RANGER 9 is shipped with the engine filled with SAE 10W-30 oil. **CHECK THE OIL LEVEL BEFORE YOU START THE ENGINE**. This is an added precaution. When full, the oil level should be up to but not over the FULL mark on the dipstick. If it is not full, add enough oil to fill it to the full mark.

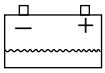
For more oil fill and service information, see the MAINTENANCE section of this manual.

FUEL

Fill the fuel tank with clean, fresh, regular grade lead-free gasoline. **DO NOT MIX OIL WITH THE GASOLINE.**

The RANGER 9 has a 9 gallon (34.1 litre), bottom mounted fuel tank with a top fill and fuel gauge. See the ***Operation*** and ***Maintenance*** sections of this manual for more details about fuel.

BATTERY CONNECTIONS



The RANGER 9 is shipped with the negative battery cable disconnected. Before you operate the machine, make sure the Engine Switch is in the STOP position and attach the disconnected cable securely to the battery terminal. If the battery is discharged and won't start the engine, see the battery charging instructions in the ***Maintenance*** section.

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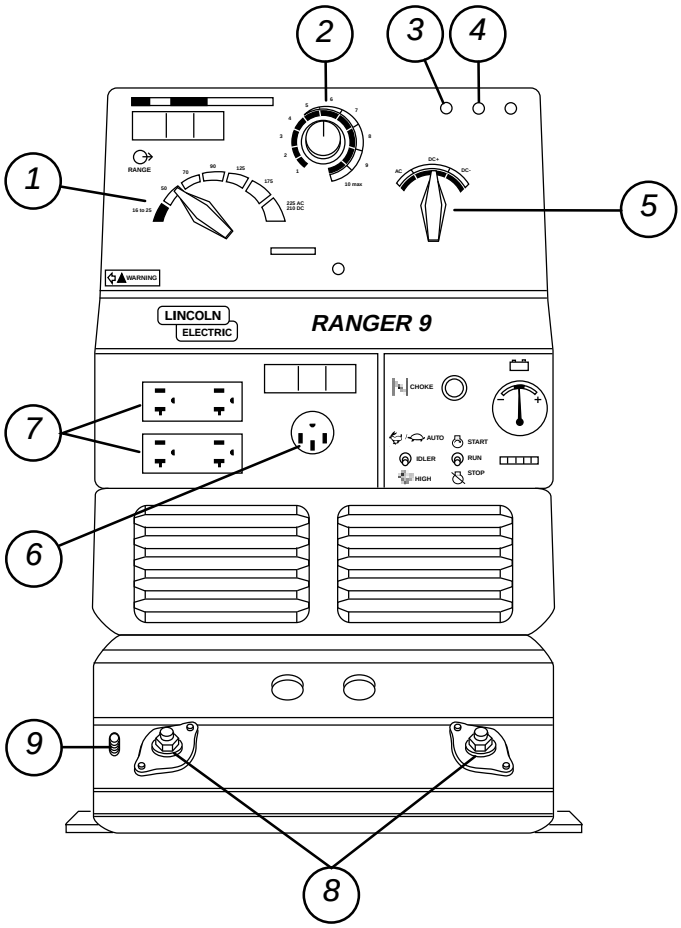
FIGURE A.1 - RANGER 9 OUTPUT CONNECTIONS



1. OUTPUT RANGE SELECTOR
2. FINE OUTPUT CONTROL
3. CONTROL AT WELDER/REMOTE CONTROL SWITCH
4. WELDING TERMINALS SWITCH
5. POLARITY SWITCH
6. 115/230 VOLT, 50 AMP RECEPTACLE
7. 115 VOLT, 20 AMP RECEPTACLES (2)
8. WELD OUTPUT TERMINALS (2)
9. GROUND STUD

MUFFLER RELOCATION

⚠ WARNING

Shut off the machine and allow the muffler to cool before touching the muffler.

The RANGER 9 is shipped with the exhaust coming out on the left side. It can be changed to the right side by removing two screws that hold the exhaust port cover in place and installing the cover on the opposite side.

NOTE: Operating the RANGER 9 without the cover in place will not increase the machine output and will result in a higher noise level.

SPARK ARRESTER

Gasoline engine mufflers may emit sparks when the engine is running. Some federal, state, or local laws require spark arresters in locations where unarrested sparks could present a fire hazard.

Standard mufflers and deflectors (like the ones included with the RANGER 9) do not act as spark arresters. When local laws require it, a spark arrester must be installed on the machine and properly maintained. An optional spark arrester kit (K894-1) is available for your RANGER 9. See the ***Accessories*** section of this manual for more information.

⚠ CAUTION

An incorrect spark arrester may lead to damage to the engine or reduce performance.

ELECTRICAL OUTPUT CONNECTIONS

See Figure A.1 for the location of the output range selector, fine output control, polarity switch, control at welder/remote control switch, welding terminals always on/remotely controlled switch 115 and 230 volt receptacles, weld output terminals, and ground stud.

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WELDING CABLE CONNECTIONS

CABLE SIZE AND LENGTH

Be sure to use welding cables that are large enough. The correct size and length becomes especially important when you are welding at a distance from the welder.

Table A.1 lists recommended cable sizes and lengths for rated current and duty cycle. Length refers to the distance from the welder to the work and back to the welder. Cable diameters are increased for long cable lengths to reduce voltage drops.

TABLE A.1 - RECOMMENDED WELDING CABLE SIZE AND LENGTH

TOTAL COMBINED LENGTH OF ELECTRODE AND WORK CABLES

Cable Length	Cable Size for 250 Amp 40% Duty Cycle	Cable Size for 250 Amp 100% Duty Cycle
0-50 feet (0-15 meters)	2 AWG	1 AWG
50-100 feet (15-39 meters)	2 AWG	1 AWG
100-150 feet (30-46 meters)	1 AWG	1 AWG
150-200 feet (46-61 meters)	1 AWG	1 AWG
200-250 feet (61-76 meters)	1/0 AWG	1/0 AWG

CABLE INSTALLATION

Install the welding cables to your RANGER 9 as follows. See Figure A.1 for the location of parts.

1. The gasoline engine must be OFF to install welding cables.
2. Remove the flanged nuts from the output terminals.
3. Connect the electrode holder and work cables to the weld output terminals. The terminals are identified on the case front.
4. Tighten the flanged nuts securely.
5. Be certain that the metal piece you are welding (the “work”) is properly connected to the work clamp and cable.
6. Check and tighten the connections periodically.

⚠ CAUTION

- Loose connections will cause the output terminals to overheat. The terminals may eventually melt.
- Do not cross the welding cables at the output terminal connection. Keep the cables isolated and separate from one another.

Lincoln Electric offers a welding accessory kit with the properly specified welding cables. See the ***Accessories*** section of this manual for more information.

For more information on welding, see WELDING OPERATION and SUMMARY OF WELDING PROCESSES in the ***Operations*** section of this manual.

MACHINE GROUNDING

Because the RANGER 9 creates its own power from its gasoline-engine driven generator, you do not need to connect the machine frame to an earth ground. However, for best protection against electrical shock, connect a heavy gauge wire (#8 AWG or larger) from the ground stud located on the bottom of the output panel (see Figure A.1) to a suitable earth ground such as a metal pipe driven into the ground.

⚠ WARNING

Do not ground the machine to a pipe that carries explosive or combustible material.

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When the RANGER 9 is mounted on a truck or a trailer, the machine generator ground stud MUST be securely connected to the metal frame of the vehicle. See Figure A.1. The ground stud is marked with the ground symbol.

If the RANGER 9 is connected to premises wiring such as a home or shop, it must be properly connected to the system earth ground. See the PREMISES WIRING section of this manual for details.

AUXILIARY POWER RECEPTACLES, PLUGS, AND HAND-HELD EQUIPMENT

The control panel of the RANGER 9 features two auxiliary power receptacles: See Figure A.1.

- Two 20 amp, 115 volt duplex (double outlet) receptacles.
- One 50 amp 115/230 volt simplex (single outlet) receptacle.

Through these receptacles the machine can supply up to 9,000 rated continuous watts of single-phase, 60 Hz AC power. The machine output voltages fall within ± 10% of the rated voltage.

For further protection against electric shock, any electrical equipment connected to the generator receptacles must use a three-blade, grounded type plug or an Underwriter's Laboratories (UL) approved double insulation system with a two-blade plug. Lincoln offers an accessory plug kit that has the right type of plugs. See the ***Accessories*** section of this manual for details.

If you need ground fault protection for hand-held equipment, refer to the ***Accessories*** section of this manual for the K896-1 GFCI Receptacle kit.

CIRCUIT BREAKERS

Canadian Standards Association (CSA) versions of the RANGER 9 are equipped with 50 amp circuit breakers on the 115/230 V receptacle and 15 amp circuit breakers on the 115 V receptacles for overload protection. Under high heat a breaker may tend to trip at lower loads than it would normally.

⚠ CAUTION

Never bypass the circuit breakers. Without overload protection, the RANGER 9 could overheat and/or cause damage to the equipment being used.

PREMISES WIRING

The RANGER 9 is suitable for temporary, standby, or emergency power using the engine manufacturer's recommended maintenance schedule. With its three-wire grounded neutral generator, it can be permanently installed as a standby power unit for 230 volt, three-wire, single phase 40 ampere service.

⚠ WARNING

Only a licensed, certified, trained electrician should install the machine to a premises or residential electrical system. Be certain that:

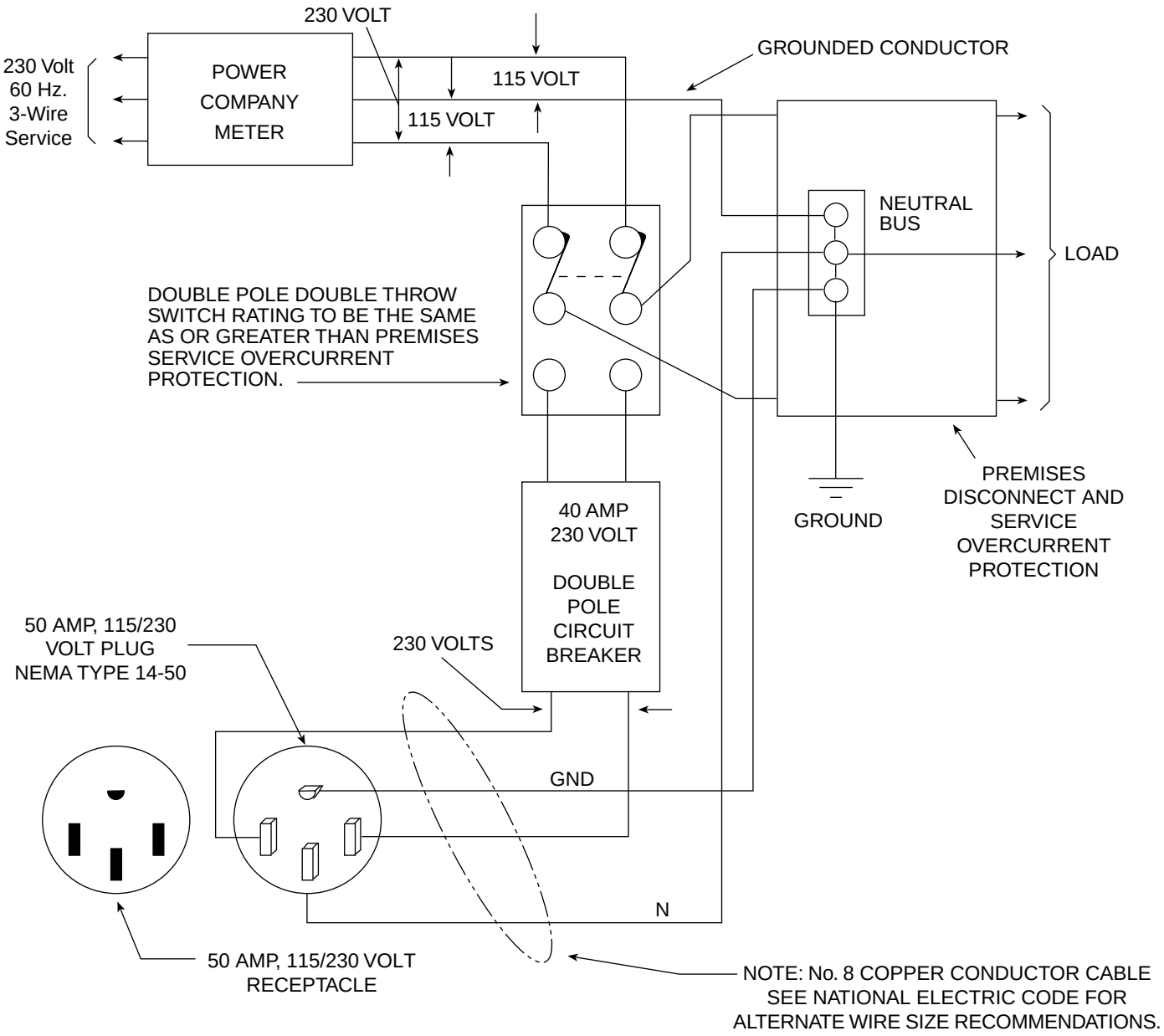
- The installation complies with the National Electrical Code and all other applicable electrical codes.
- The premises is isolated and no feedbacking into the utility system can occur. Certain state and local laws require the premises to be isolated before the generator is linked to the premises. Check your state and local requirements.
- A double pole, double throw transfer switch in conjunction with the properly rated double throw circuit breaker is connected between the generator power and the utility meter.

The following information and the connection diagram, Figure A.2, can be used as a guide by the electrician for most applications to premises wiring.

1. Install a double pole, double throw switch between the power company meter and the premises disconnect. **The switch rating must be the same as or greater than the premises disconnect and service overcurrent protection.**
2. Take the necessary steps to assure that the load is limited to the capacity of the RANGER 9 by installing a 40 amp 230 volt double pole circuit breaker. Maximum rated load for the 230 volt auxiliary is 40 amperes. Loading above 40 amperes will reduce output voltage below the allowable – 10% of rated voltage. This may damage appliances or other motor-driven equipment.
3. Install a 50 amp 115/230 volt plug (NEMA type 14-50) to a double pole circuit breaker using No. 8, 4 conductor cable of the desired length. (The 50 amp 115/230 volt plug is available in the optional power plug kit. See the ***Accessories*** section for details.)
4. Plug this cable into the 50 amp 115/230 volt receptacle on the RANGER 9 case front.

INSTALLATION

FIGURE A.2 - CONNECTION OF RANGER 9 TO PREMISES WIRING



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OPERATING INSTRUCTIONS

Read and understand this entire section before operating your RANGER 9.

SAFETY INSTRUCTIONS

⚠ WARNING

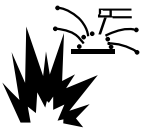
Do not attempt to use this equipment until you have thoroughly read all the operation and maintenance manuals supplied with your machine. They include important safety precautions; detailed engine starting, operating, and maintenance instructions; and parts lists.

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrodes with your skin or wet clothing.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.

FUMES AND GASES can be dangerous.

- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.



WELDING SPARKS can cause fire or explosion.

- Keep flammable material away.
- Do not weld on containers that have held combustibles.

⚠ WARNING

ARC RAYS can burn.

- Wear eye, ear, and body protection.

ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust to the outside.
- Do not stack anything on or near the engine.

MOVING PARTS can injure.

- Do not operate this equipment with any of its doors open or guards off.
- Stop the engine before servicing it.
- Keep away from moving parts.

Only qualified personnel should install, use, or service this equipment.

GENERAL DESCRIPTION

The RANGER 9 is a gasoline-engine driven, multi-process arc welder and AC power generator for commercial and residential applications. As a generator it can supply up to 9,000 continuous watts of 115/230 volt, 60 Hz, single-phase AC power to operate AC power tools, battery chargers, and lighting; it can also be used to provide standby power. As a welder it provides 250 amps of AC current for welding with AC stick electrodes or 250 amps of DC current for DC stick welding. The RANGER 9 can also perform AC/DC TIG welding and DC semiautomatic wire feed welding.

The RANGER 9 is powered by the Onan P218 Performer® air-cooled, twin-cylinder engine.

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RECOMMENDED APPLICATIONS

WELDER

The RANGER 9 provides excellent constant current AC/DC welding output for stick (SMAW) welding and for TIG welding, and it offers constant voltage output for DC semiautomatic wire feed welding. For more details on using the machine as a welder, see WELDING OPERATION in the ***Operation*** section of this manual.

GENERATOR

The RANGER 9 gives AC generator output for medium use demands. For more details on operating the generator, see AUXILIARY POWER in the ***Operation*** section of this manual.

OPERATIONAL FEATURES AND CONTROLS

The RANGER 9 was designed for simplicity. Therefore, it has very few operating controls. Three switches are used for welding operations:

- A nine-position output range selector switch selects current output for constant current stick or TIG applications and constant voltage wire feed applications.
- A fine output control switch for fine adjustment of current or voltage within the selected output range
- A three-position polarity switch for selecting DC+, DC- or AC welding output.
- A two-position toggle switch for selecting between CONTROL AT WELDER or REMOTE CONTROL (Remote control connections are made at either the 6 pin or the 14 pin amphenol connector.
- A two-position toggle switch for selecting between control of the output contactor by the RANGER 9 (WELDING TERMINALS ALWAYS ON) or control of the output contactor by a cable from a wire feeder gun (WELDING TERMINALS REMOTELY CONTROLLED).

The gasoline engine control is a three-position toggle switch for START, RUN, and STOP and a two-position “IDLER” switch that selects engine speed for welding or auxiliary power applications. See ENGINE OPERATION in the ***Operation*** section of this manual for details about starting, running, stopping, and breaking in the gasoline engine.

DESIGN FEATURES AND ADVANTAGES

- 9,000 watts of auxiliary power
- Enhanced constant voltage capability with low (12-21 volts), medium (15-27 volts), and high (18-35 volts) range settings for greater control of wire feed applications.
- Built-in contactor with front panel selection of “cold” or “hot” welding terminals: Cold (WELDING TERMINALS REMOTELY CONTROLLED) – Closing wire feeder trigger switch or amptrol causes contactor to close and engine to accelerate to high idle. Hot (WELDING TERMINALS ALWAYS ON) – The contactor is closed and welding begins when electrode touches work; engine automatically goes to high idle.
- Constant current AC/DC Stick welding (SMAW) process capability with output range from 40-250 amps (AC) or 40-250 amps (DC).
- Constant voltage DC Semiautomatic Wire Feed Welding with output range from 40-250 amps.
- Constant current AC/DC TIG Welding with output across the entire range of settings.
- Polarity switch for selecting DC+, DC-, or AC welding output.
- Separate ground stud for safe connection of case to earth ground.
- Single 50 amp, 230 volt, full 9 kVA auxiliary power receptacle.
- Double duplex 20 amp, 115 volt auxiliary power receptacles.
- Electric starting.
- Battery Charging Ammeter.
- Engine Hour Meter for determining periodic maintenance.
- Top-of-the-line 18 HP Onan P218 Performer® engine.
- Durable, heavy-gauge steel case.
- Built-in feet for easy mounting to truck bed or trailer.
- Bottom-mounted 10 gallon (38.0 litre) fuel tank with convenient top fill and fuel gauge.

- Quiet engine muffler with reversible exhaust feature for right or left side.
- All copper alternator windings and high quality insulation for dependable long life.
- Automatic engine shutdown protection for low oil pressure.
- Automatic engine idler goes to low idle 10 to 14 seconds after welding for greater fuel economy; includes high idle switch.
- Standard Remote Control Receptacle provides interface for Lincoln remote control accessories. Both 6 pin and 14 pin amphenols are provided for ease in hooking up wire feeders.
- Canadian Standard Association (CSA) approved models available; include integrated generator output overload protection through two 50 amp circuit breakers.

WELDING CAPABILITY

The RANGER 9 is rated 250 amps, 25 volts constant current AC or 250 amps, 25 volts constant current DC (250 amps 25 volts constant voltage DC) at 100% duty cycle on a ten-minute basis.

The current is continuously variable from 40 to 250 amps AC or 40 to 250 amps DC. The RANGER 9 can weld with all 3/32 and most 1/8 inch and 1/16 diameter Lincoln AC stick electrodes. Wire feed processes using wire diameters from .030 to .068 inch are possible, depending on the specific process and wire feeder. (See LIMITATIONS.)

LIMITATIONS

- The RANGER 9 is not recommended for any processes besides those that are normally performed using stick welding (SMAW), TIG welding, MIG (GMAW) welding and Innershield® (FCAW) welding. Specific limitations on using the RANGER 9 for these processes are described in the WELDING OPERATION section of this manual.
- The RANGER 9 is not recommended for pipe thawing.
- During welding, generator power is limited and output voltages can drop. Therefore, DO NOT OPERATE ANY SENSITIVE ELECTRICAL EQUIPMENT WHILE YOU ARE WELDING. See Table B.4 for permissible simultaneous welding and auxiliary power loads.

CONTROLS AND SETTINGS

All generator/welder controls are located on the Output Control Panel of the machine case front. Gasoline engine choke control, idler control, and start/stop controls are also on the case front. See Figure B.1 and the explanations that follow.

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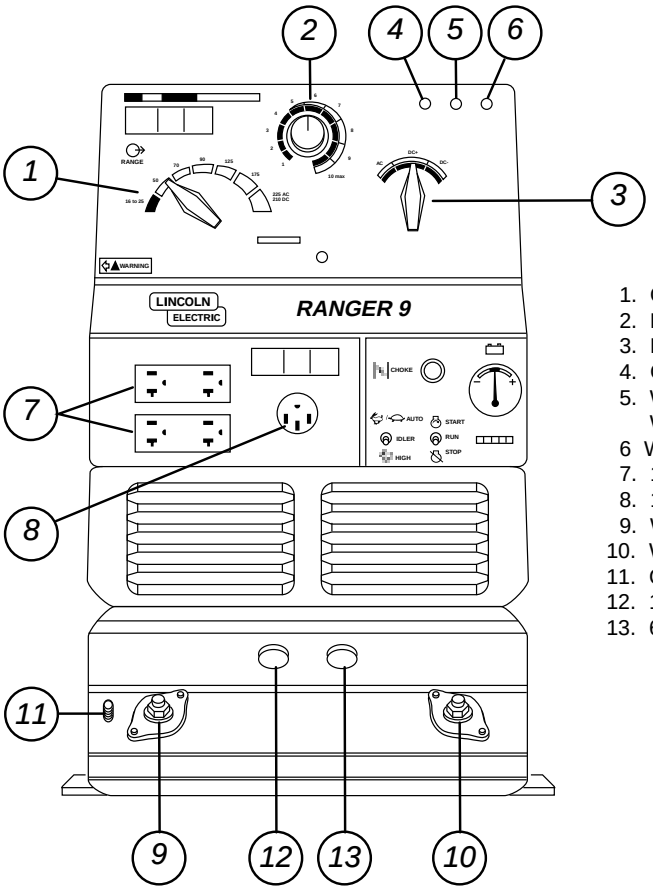
FIGURE B.1 – OUTPUT PANEL CONTROLS



1. OUTPUT RANGE SELECTOR
2. FINE OUTPUT CONTROL
3. POLARITY SWITCH
4. CONTROL AT WELDER/REMOTE CONTROL SWITCH
5. WELDING TERMINALS ALWAYS ON/ WELDING TERMINALS REMOTELY CONTROLLED SWITCH
6. WIRE FEEDER POWER CIRCUIT BREAKER
7. 115 VOLT, 20 AMP RECEPTACLES (2)
8. 115/230 VOLT, 50 AMP RECEPTACLE
9. WELD OUTPUT TERMINAL (TO WORK)
10. WELD OUTPUT TERMINAL (TO ELECTRODE HOLDER)
11. GROUND STUD
12. 14 PIN AMPHENOL
13. 6 PIN AMPHENOL

WELDER/GENERATOR CONTROLS

See Figure B.1 for the location of the following features:

1. OUTPUT RANGE SELECTOR: Selects continuous current output for constant current stick or TIG applications (blue settings) and constant voltage wire feed applications (red settings). The amperages on the dial correspond to the maximum amperages for each corresponding range setting. **Never change the range switch setting while welding since this could damage the switch.**
2. FINE OUTPUT CONTROL: Allows fine adjustment of current or voltage within the selected output range.
3. POLARITY SWITCH: Selects DC+, DC- or AC welding output. Color codings aid in the proper selection of stick (blue) or wire feed (red) polarity setting. The color setting of the polarity switch must match the color setting of the OUTPUT RANGE SELECTOR. **Never change the polarity switch setting while welding since this could damage the switch.**
4. CONTROL AT WELDER/REMOTE CONTROL SWITCH: Allows the operator to control welding output at the welding control panel or at a remote station. Remote connections are made at the 6 pin or 14 pin amphenol connector.
5. WELDING TERMINALS ALWAYS ON/WELDING TERMINALS REMOTELY CONTROLLED SWITCH: Allows control of the RANGER 9 output contactor. In the ALWAYS ON position, the switch closes the output contactor, and welding begins when an arc is struck between the electrode and the workpiece. In the REMOTELY CONTROLLED position, the switch places control of the contactor at the wire feeder. The contactor closes when the wire feeder gun trigger or amptrol switch closes and opens when it is released.
6. WIRE FEEDER POWER CIRUIT BREAKER: Opens the wire feeder circuit and disables the feeder if a fault is detected in the circuit.

7. 20 AMP, 115 VOLT DUPLEX RECEPTACLES: Connection point for supplying 115 volt power to operate one or two electrical devices.
8. 50 AMP, 230 VOLT RECEPTACLE: Connection point for supplying 230 volt power to operate one electrical device.
9. WELD OUTPUT TERMINAL (TO WORK) WITH FLANGE NUT: Provides the connection point for the work cable.
10. WELD OUTPUT TERMINAL (TO ELECTRODE HOLDER) WITH FLANGE NUT: Provides the connection point for the electrode holder.
11. GROUND STUD: Provides a connection point for connecting the machine case to earth ground for the safest grounding procedure.
12. 14 PIN AMPHENOL: For attaching wire feeder control cables to the RANGER 9.
13. 6 PIN AMPHENOL: For attaching optional remote control equipment to the RANGER 9.

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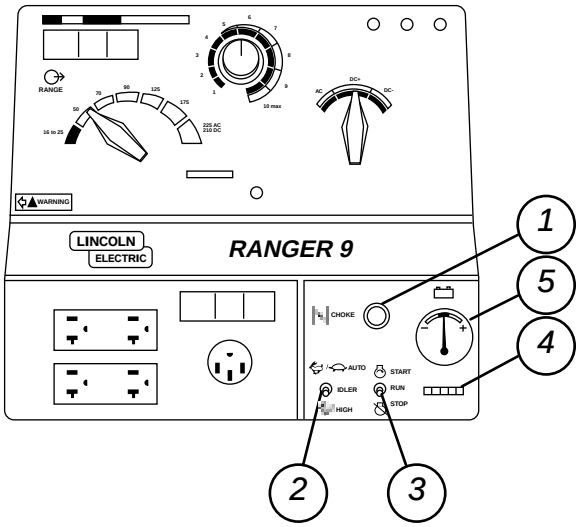
FIGURE B.2 – GASOLINE ENGINE CONTROLS

1. ENGINE CHOKE CONTROL
2. IDLER CONTROL SWITCH
3. START/STOP SWITCH
4. ENGINE HOUR METER
5. BATTERY CHARGING SYSTEM METER



GASOLINE ENGINE CONTROLS

See Figure B.2 for the location of the following features:

1. **ENGINE CHOKE CONTROL:** Provides a richer air/fuel mixture for cold engine starting conditions. See the topic ENGINE OPERATION, below, for details on setting the choke.

2. **IDLER CONTROL SWITCH:** Adjusts the running speed of the engine. The switch has two positions, HIGH and AUTO. In HIGH, the engine runs continuously at high idle. In AUTO, the idler control works as follows:

Stick Welding, "WELDING TERMINALS ALWAYS ON" mode: The engine accelerates to high speed when the electrode touches the work and strikes a welding arc. The engine returns to low idle approximately 10-14 seconds after welding stops, as long as no auxiliary power is being drawn.

Wire Welding, "WELDING TERMINALS ALWAYS ON" mode: The engine accelerates to high speed when the wire feeder gun trigger or amptrol is closed. The engine returns to low idle approximately 10-14 seconds after the gun trigger is released and the welding stops, provided that no auxiliary power is being drawn.

Auxiliary Power: The engine accelerates to high speed when power is drawn at the receptacles for lights or tools. The engine returns to low idle approximately 10-14 seconds after demand for auxiliary power stops.

3. **START/STOP SWITCH:** Has three positions, START, RUN, and STOP. When the switch is held in the START position, the starter motor cranks over the engine – release the switch once the engine starts. The STOP position stops the engine.

   NOTE: If you place the switch in the START position when the engine is running, you may damage the ring gear or starter motor.

4. **ENGINE HOUR METER:** Records engine running time. Use the meter to determine when to perform required maintenance.

5. **BATTERY CHARGING SYSTEM METER:** Shows whether the charging circuit is performing its job of charging the battery when the engine is running. The meter will register discharge during starting, but then the needle should return to a position slightly toward positive during running. The needle will hold position when the engine stops.

ENGINE OPERATION

⚠ WARNING

DO NOT RUN THE ENGINE AT EXCESSIVE SPEEDS. The maximum allowable high idle speed for the RANGER 9 is 3750 RPM, no load. Do NOT adjust the governor screw on the engine. Severe personal injury and damage to the machine can result if it is operated at speeds above the maximum rated speed.

Read and understand all safety instructions included in the Onan instruction manual that is shipped with your RANGER 9.

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OPERATION

BEFORE STARTING THE ENGINE

Check and fill the engine oil level:

1. Be sure the machine is on a level surface.
2. Remove the engine oil dipstick and wipe it with a clean cloth. Reinsert the dipstick and check the level on the dipstick. On the Onan engine, the oil fill cap and dipstick are a unit. See Figure D.1 in the ***Maintenance*** section of this manual.
3. Add oil (if necessary) to bring the level up to the full mark. Do not overfill.

Replace the dipstick and tighten it securely.

Check and fill the engine fuel tank:

1. Remove the fuel tank cap.
2. Fill the tank approximately 4 inches (100 mm) from the top of the filler neck to allow for fuel expansion (observe the fuel gauge). DO NOT FILL THE TANK TO THE POINT OF OVERFLOW.
3. Replace the fuel tank cap and tighten securely.

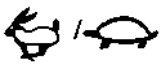
NOTE: Use only fresh, **unleaded** gasoline with octane rating 87 or higher. Gasoline/alcohol blends are approved for use with your engine as long as the blend does not exceed 10% ethyl alcohol by volume. Other gasoline/alcohol blends are not approved, and their use may damage fuel system and engine parts. **NOTE:** Purchase gasoline in quantities that will be used within 30 days, to assure freshness.

STARTING THE ENGINE

NOTE: Remove all loads connected to the AC power receptacles before starting the gasoline engine.

For a "cold" engine:

1. Set the Idler Control Switch in the AUTO position.



Use the Choke Control as follows:

If the engine is cold, pull the choke control out. If the engine is warm or hot, DO NOT use the choke control.

2. Hold the Engine Switch in the START position. Release the switch when the engine starts. Slowly return the choke control to the full "in" position.

The engine will run at high idle for 10-14 seconds, then go to low idle.

3. Let the engine run at low idle for a few minutes to warm up before you use the RANGER 9 for welding or auxiliary power.

If the engine will not start, see the ***Trouble-shooting*** section of this manual.

STOPPING THE ENGINE

1. Remove all welding and generator power loads and let the engine cool by running it for several minutes at low idle.
2. Stop the engine by placing the Engine Switch in the STOP position.

A fuel shutoff valve is not required on the RANGER 9 because the fuel tank is mounted below the engine.

BREAK-IN PERIOD

Any engine will use a small amount of oil during its "break-in" period. For the gasoline engine on the RANGER 9, break-in is about 50 running hours.

Check the oil at least twice a day during break-in. Change the oil after the first 25 hours of operation. Change the oil filter at the second oil change. For more details, see the ***Maintenance*** section of this manual.

⚠ CAUTION

During break-in, subject the RANGER 9 to moderate loads. Avoid long periods running at idle. Before stopping the engine, remove all loads and allow the engine to cool several minutes.

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TABLE B.1
TYPICAL RANGER 9 FUEL CONSUMPTION

ONAN P218 PERFORMER	
Low Idle – No Load, 2150 RPM	.40 Gallons/hour (1.5 liters/hour)
High Idle – No Load, 3700 RPM	.82 Gallons/hour (3.10 liters/hour)
AC CC Weld Output, 250 Amps @ 25 Volts	1.7 Gallons/hour (6.5 liters/hour)
DC CC Weld Output, 250 Amps @ 25 Volts	1.7 Gallons/hour (6.5 liters/hour)
DC CV Weld Output, 250 Amps @ 25 Volts	1.7 Gallons/hour (6.5 liters/hour)
Auxiliary Power, 9000 kVA	1.7 Gallons/hour (6.5 liters/hour)

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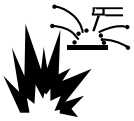
WELDING OPERATION

GENERAL INFORMATION

⚠ WARNING

- Do not touch electrically live parts or electrodes with your skin or wet clothing.

- Do not breathe welding fumes or gases.
- Use ventilation or exhaust to remove welding fumes from the breathing area.



- Keep flammable material away.
- Wear eye, ear, and body protection.

The RANGER 9 can deliver from 40 to 250 amps of constant current for AC/DC stick welding or from 40 to 250 amps of constant voltage current for DC semiautomatic wire feed welding. AC/DC TIG welding is possible across the entire range from 40 to to maximum rated output. Output can be adjusted by setting the POLARITY SWITCH, the OUTPUT RANGE dial, and the FINE CONTROL dial on the output control panel to the settings that are best for your selected welding process.

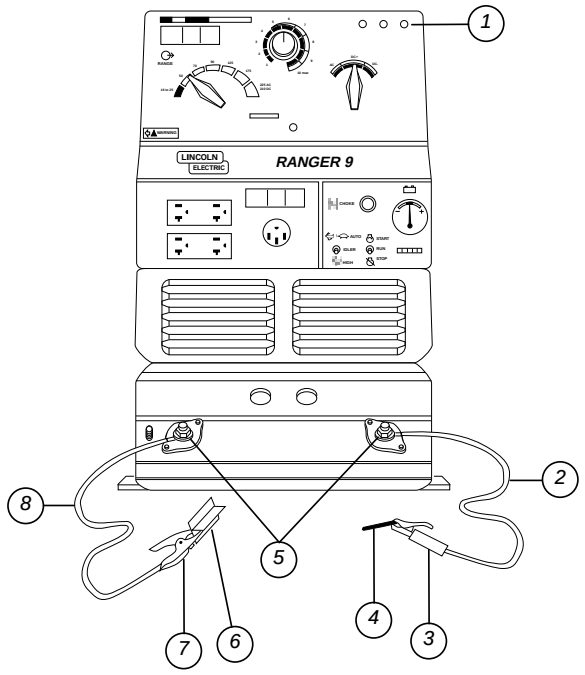
To use the RANGER 9 for AC/DC Constant Current Stick Welding:

1. Remove the flange nuts from output terminals and place the work and electrode welding cables over the terminals. See Figure B.3. Replace and tighten the flange nuts securely. Be sure the connections are tight.
2. Select the appropriate electrode. See “Welding Tips 1” included with your RANGER 9.
3. Attach the work clamp securely to the work you are welding.
4. Insert the electrode into the electrode holder.
5. Set the IDLER CONTROL to AUTO and start the gasoline engine. See ENGINE OPERATION in this section of the manual.
6. Set the OUTPUT RANGE dial to a setting equal to or slightly higher than the welding current recommended for the electrode being used.
7. Set the POLARITY SWITCH to the desired polarity.
8. Set the FINE OUTPUT CONTROL. Use a setting that results in the highest output at the lowest setting of the RANGE switch for the application.
9. Strike an arc and begin welding.

After you finish welding:

1. Stop the gasoline engine. See ENGINE OPERATION in this section of the manual.
2. Allow the electrode and work to cool completely.
3. Remove the work clamp from the work.
4. Remove any remaining piece of electrode from the electrode holder.
5. If you are finished using the RANGER 9 for welding, disconnect the welding cables from the weld output terminals. Reattach the flange nuts and leave them on the terminals.

FIGURE B.3 – WELDING CIRCUIT CONNECTIONS FOR STICK WELDING



1. OUTPUT CONTROL PANEL
2. ELECTRODE CABLE
3. ELECTRODE HOLDER
4. ELECTRODE
5. OUTPUT TERMINALS
6. WORK
7. WORK CLAMP
8. WORK CABLE

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To Use the RANGER 9 for AC/DC TIG (Constant Current) Welding:

1. Connect the K930-1 TIG Module to the RANGER 9. Follow the installation instructions provided with the kit. Also be sure to follow the special machine grounding instructions given in the manual.
2. Refer to the instruction manual with the TIG module (IM 528) for operation with a RANGER 9 and proper machine settings.
3. Set the OUTPUT RANGE dial to the appropriate setting for the electrode you are using. Refer to IM -528 with the TIG module or refer to Table B.2 for AC TIG welding.
4. Set the POLARITY SWITCH to the desired polarity.
5. Do not AC TIG weld on the 250 AC range setting. The output current may exceed the rating of the RANGER 9.
6. Start the arc and begin welding.

NOTE: When using the RANGER 9 for AC TIG welding of aluminum, the TIG Module is to be set for CONTINUOUS HF.

After you finish welding:

1. Stop the gasoline engine. See ENGINE OPERATION in this section of the manual.
2. Allow the electrode and work to cool completely.
3. Remove the work clamp from the work.

TABLE B.2 - AC TIG WELDING – TIG ELECTRODE/RANGE SETTINGS

Settings for Pure Tungsten		
Tungsten Diameter (inches)	**Range Switch Settings**	**Appropriate Current Range**
1/8	90 or 120	160 - 200 Amps
3/32	45 or 90	45 - 140 Amps
1/16	45 or 90	45 - 100 Amps

Settings for 1% Thoriated Tungsten		
Tungsten Diameter (inches)	**Range Switch Settings**	**Appropriate Current Range**
1/8	90, 120, or 180	160 - 250 Amps
3/32	45, 90, or 120	100 - 180 Amps
1/16	45 or 90	60 - 120 Amps

To Use the RANGER 9 for DC Wire Feed Welding (Constant Voltage):

1. Connect one of the following: the LN-25, LN-7, LN-8, or LN-742 Wire Feeder. Follow the installation instructions in the ACCESSORIES section of this manual.
2. Some recommended Innershield electrodes are: NR-211MP, NR-311, NR-203 series, as well as Lincore® 33 and 55 hardfacing electrodes. Diameters from .035 (0.9mm) up to and including 5/64" (2.0mm) can be used. 5/64" (2.0mm) NS-3M can be used in limited applications. Cable length and other conditions can affect the ultimate results of this application. Request Lincoln publication N-675 for additional information.

   Recommended Outershield electrodes are .045, .052, and 1/16 Outershield 71 and 1/16 Outershield 70. Request Lincoln publication GS-200 for additional information.

   For MIG welding, the recommended electrodes are .030, .035 and .045 L-50 and L-56. You must use a blended shielding gas such as C25 (75% Argon, 25% CO^2). Request Lincoln publication GS-100 for additional information.
3. Set the IDLER CONTROL to "AUTO" for the LN-25 or LN-742 or "HIGH" for the LN-7 or LN-8 and start the gasoline engine. See ENGINE OPERATION in this section of the manual.
4. Set the OUTPUT RANGE dial to either HIGH, MED, or LOW depending on your wire size and speed.
5. Set the POLARITY SWITCH to either WIRE FEED DC+ or WIRE FEED DC- (red), depending on the electrode.
6. Set the FINE OUTPUT CONTROL to a setting that gives the most stable arc for the application.
7. Strike an arc and begin welding.

After you finish welding:

1. Stop the gasoline engine. See ENGINE OPERATION in this section of the manual.
2. Allow the work to cool completely. The wire gun and wire are "cold."
3. Remove the work clamp from the work.

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SUMMARY OF WELDING PROCESSES AND MACHINE SETTINGS

Table B.3 summarizes the requirements for various welding processes you can perform with the RANGER 9.

TABLE B.3 - SUMMARY OF WELDING PROCESSES

Process	Control Cable Used	Idle Mode	Output Control Switch	Welding Terminals Switch	Electrode State When Not Welding	To Start Welding
Stick – CC	No	Auto	At Welder	Always on	Hot	Touch electrode to work. Welding starts immediately and engine goes to high idle.
TIG - CC K930-1/K936-1 (With Amptrol)	Yes	Auto	Remote	Remote	Cold	Press Amptrol. Welding starts immediately.
Wire Feed - CV, LN-25 with 42V Remote Control Kit	Yes	Auto	Remote	Remote	Cold	Press gun trigger, RANGER 9 contactor closes. Welding starts immediately and engine goes to high idle.
Wire Feed - CV LN-25 with internal contactor	No	Auto	At Welder	Always on	Cold	Press gun trigger, LN-25 contactor closes. Welding starts immediately and engine goes to high idle.
Wire Feed - CV LN-742	Yes	Auto	Remote	Remote	Cold	Press gun trigger, RANGER 9 contactor closes. Welding starts immediately and engine goes to high idle.
Wire Feed - CV, LN-7	Yes	High	Remote	Remote	Cold	Press gun trigger, RANGER 9 contactor closes. Welding starts immediately.

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AUXILIARY POWER

⚠ WARNING

Be sure that any electrical equipment plugged into the generator AC power receptacles can withstand a ±10% voltage and a ±3% frequency variation.

GENERAL INFORMATION

The RANGER 9 generator is rated at 9000 continuous watts. It provides both 115 volt and 230 volt power. You can draw up to 80 amps total from the 115 volt receptacles, but no more than 20 amps (15 amps CSA) from each receptacle at once. See Tables B.4A and B.4B. Up to 40 amps can be drawn from the single 230 volt receptacle.

The current rating of any plug used must be at least equal to the current load being drawn from the receptacle. Do not try to connect the receptacles in parallel.

Electrical loads in watts are calculated by multiplying the voltage rating of the load by the number of amps it draws. (This information is given on the load device nameplate.) For example, a device rated 115 volts, 2 amps will need 230 watts of power (115 x 2 = 230).

You can use Table B.6, GENERATOR POWER APPLICATIONS, to determine the wattage requirements of some common types of loads you can power with the RANGER 9. Be sure to read the notes at the bottom of the table.

Powering Motors

You can start most 1.5 HP, single-phase electric motors if there is no load on the motor or other load connected to the RANGER 9. After starting, the motor may be run at full load. Larger motors (up to 2 HP) may be started and run as long as you don't exceed the current rating of the receptacle. This may mean that only 230 volt motors of this size may be operated.

Using Auxiliary Power and Welding at the Same Time

It is possible to weld and use the RANGER 9 for auxiliary power at the same time. However, the size of the loads you can power is reduced when you weld. See Table B.5 in this section of the manual for a list of permissible simultaneous welding and load ratings. The table assumes that power is being drawn from either a 115 volt or the 230 volt receptacle, but not both at the same time.

NOTE: For simultaneous welding and power, set the OUTPUT CONTROL at "10" for maximum auxiliary power. At settings below "10," only incandescent loads should be connected to the auxiliary receptacles.

To use the generator as an auxiliary power supply:

1. Start the gasoline engine. See ENGINE OPERATION in this section of the manual.
2. Set the IDLER CONTROL to the desired operating mode, HIGH or AUTO. Set the OUTPUT CONTROL to "10." See Figure B.1.
3. Plug the load(s) into the appropriate 115 volt or 230 volt power receptacle.

NOTE: The 115 volt auxillary power receptacles should only be used with three-wire grounded type plugs or approved double insulated devices with two-wire plugs.

TABLE B.4A
MAXIMUM CURRENT DRAW FROM 115V DUPLEX RECEPTACLES – NO WELDING

Load From 115V/230V Dual Voltage Receptacle	K1420-1		K1420-2 (CSA)	
	Each Half of Each 115V Duplex	Total from Both 115V Duplexes	Each Half of Each 115V Duplex	Total from Both 115V Duplexes
0	20*	78	15	60
2.2 KW	20*	60	15	60
4.5 KW	20*	40	15	40
6.7 KW	20*	20	15	20
9.0 KW	0	0	0	0

*NEMA 5-20P plug required for 20 amp draw.

TABLE B.4B
MAXIMUM CURRENT DRAW FROM OPTIONAL 115V GFCI DUPLEX RECEPTACLES – NO WELDING

Load From 115V/230V Dual Voltage Receptacle	K1420-1*		K1420-2**	
	Each Half of Each 115V Duplex	Total from Both 115V Duplexes	Each Half of Each 115V Duplex	Total from Both 115V Duplexes
0	15	40	15	30
2.2 KW	15	40	15	30
4.5 KW	15	40	15	30
6.7 KW	15	20	15	20
9.0 KW	0	0	0	0

*Maximum current draw from each 115V GFCI Duplex is 20 amps.
**Maximum current draw from each 115V GFCI Duplex is 15 amps.

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TABLE B.5 - SIMULTANEOUS WELDING AND AUXILIARY POWER

Output Selector Setting	Welding Output	Permissible Power in Watts (Unity Power Factor)	Permissible Auxiliary Current in Amperes @ 115V	@230V
250	250	None	—	—
200	200	2500	22	11
160	160	3700	32	16
120	120	5000	44	22
90	90	6000	52	26
45	45	7500	65	32.5
CV Low	200	5000	43	21.5
	60	7500	65	32.5
CV Medium	250	2750	40	20
	80	6500	56	28
CV High	250	1200	10	5
	100	6000	52	26

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TABLE B.6
TYPICAL GENERATOR POWER APPLICATIONS

Suggested Power Applications	Running Watts	*Start-up Watts
*Air Compressor - 3/4 HP	1,250	3,100 - 5,000
*Airless Sprayer - 1/3 HP	600	1,500 - 2,400
Chain Saw	1,200	
Circular Saw	1,200	
Coffee Maker	1,000	
*Deep Freezer	500	750 - 2,000
*Electric Motor - 1 HP	1,000	2,500 - 4,000
Electric Range (1 element)	1,500	
Electric Skillet	1,250	
*Furnace Fan - 1/3 HP	1,200	3,000 - 4,800
Portable Grinder (4 1/2”)	600	
Portable Grinder (7”)	2,000	
Halogen Work Light	500	
Hand Drill - 1/4”	500	
Hand Drill - 3/8”	700	
1500 Watt Heater	1,750	
Hedge Trimmer	450	
Light Bulb	100	
Reciprocating Saw	900	
Radial Arm Saw	2,600	
Radio	50	
*Refrigerator/Freezer (small)	600	1,500 - 2,400
Slow Cooker	200	
*Submersible Pump - 1 HP	1,000	2,500 - 4,000
*Sump Pump	600	1,500 - 2,400
Toaster	1,100	
Weed Trimmer	500	
Lincoln 100 or 125 Amp Wire Feeder/Welder	4,000	

NOTES:

Wattages listed are approximate. Check your equipment for actual wattage.

Equipment with unusually high *START-UP WATTS are listed. For start-up of other equipment listed in the table, multiply RUNNING WATTS by 2.

Multiple loads can be used as long as the total load does not exceed 9,000 watts. Be sure to start the largest loads first. For example, a 1 HP motor needs approximately 1,000 watts while running but may require 2,500 watts to start. Some inductive motors may require as much as 4 times running watts to start.

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OPTIONS/ACCESSORIES

The following options/accessories are available for your RANGER 9 from your local Lincoln Distributor.

Two-Wheel Trailer (K768-2) – For in-plant or yard towing of the RANGER 9. (Not intended for highway towing as equipped. For highway use of this trailer, consult applicable federal, state, and local laws about possible requirements for brakes, lights, fenders, etc.

Two-Wheel Undercarriage (K889-2) – For moving the RANGER 9 by hand. Overall width is 29 inches (74 mm).

Caster for Undercarriage (K893-1) – Mounts to the front of the K889-2 to allow easy movement on smooth surfaces. Includes a 6 inch (152.4 mm) diameter hard rubber wheel and convenient toe-on, toe-off locking brake.

Four-Wheel Undercarriage (K933-1) – Allows movement of the RANGER 9 by hand without lifting. Easily assembles to RANGER 9. Includes two rugged, hard molded wheels and two durable pneumatic tires. The spring loaded handle provides convenient, comfortable steering. The K934-1 Bracket is available for mounting a gas cylinder on the undercarriage.

Bracket for Mounting a Gas Cylinder to a K933-1 Undercarriage (K934-1) – Easily mounts on the back of the K933-1 Four Wheel Undercarriage to carry a welding gas cylinder.

Canvas Cover (K886-1) – For protecting the RANGER 9 when it's not in use. Material is flame retardant, mildew resistant, and water repellent. Color: red.

Power Plug Kit (K802-N) – Provides four 20 amp, 115 volt plugs and one 50 amp, dual voltage (115/230V), full kVA plug. NOTE: For CSA machines K1418-2 or K1419-2 and machines with GFCI receptacles, use Power Plug Kit K802-R.)

Power Plug Kit (K802-R) –Provides four 15 amp, 115 volt plugs and one 50 amp, dual voltage (115/230V), full kVA plug.

Accessory Kit (K702) – Includes the following:

- Thirty-five feet (10.5 meters) of #2 AWG electrode cable
- Thirty feet (9.1 meters) of #2 AWG work cable
- Headshield with No. 12 filter.
- GC300 work clamp
- Cooltong® 300 insulated electrode holder

The cables are rated at 250 amps, 40% duty cycle.

Spark Arrester Kit (K894-1) – A field-installed kit for the RANGER 9 gasoline engine muffler exhaust pipe (either engine option). Includes a heavy-gauge steel, approved spark arrester and mounting clamp.

Rotor Removal Kit (S20788) – A service kit with thru and impact bolts for removing the generator rotor from the tapered engine crankshaft.

Remote Control (K857) – Includes a control box with 25 feet (7.5 meters) of 4-conductor cable. Allows output voltage to be controlled remotely.

GFCI Receptacle Kit (K896-1) – Includes two UL approved 115 volt ground fault circuit interrupter receptacles (duplex type) with covers and installation instructions. Each receptacle is rated 15 amps, but the maximum total current from each GFCI duplex is limited to 20 amps. The GFCI receptacles replace the two factory installed 115 volt duplex receptacles.

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ACCESSORIES

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TIG WELDING

TIG Module (K930-1) - The TIG Module is an accessory that provides high frequency and shielding gas control for AC and DC GTAW (TIG) welding applications. It provides contactor control of constant current welding power sources having an internal contactor.

The K930-1 TIG Module is supplied without accessories. Arc Start switches, Amptrols, cables, torches and mounting brackets must be purchased separately.

Docking Kit (K939-1) - For mounting the K930-1 TIG Module on top of the RANGER 9.

Control Cable (K936-1) - Control cable for connecting the K930-1 TIG Module to a RANGER 9 9-Socket (at the TIG Module) to 14-pin (at RANGER 9). (Contains circuits 2, 4, 31, 32, 75, 76, 77 and ground.)

Arc Start Switch (K814) - A remote start switch used in conjunction with the K930-1 TIG Module to energize the output terminals via the TIG Module.

K812 – Hand Amptrol.

K870 – Foot Amptrol.

NOTE: TIG welding requires a Magnum™ TIG Gun, appropriate Magnum Parts Kit and argon gas.

SEMIAUTOMATIC FCAW AND MIG WELDING

LN-25 Wire Feeder K449 – This portable unit provides CC/CV for flux-cored arc welding (FCAW) and metal inert gas welding (MIG). Includes a gas solenoid and an internal contactor that allows across-the-arc operation with no control cable. The LN-25 provides a "cold" electrode until the gun trigger is pressed. For voltage control at the feeder, a K444-1 Remote Voltage Control Kit is required. Refer to connection instructions later in this section.

LN-7 or LN-8 Wire Feeder – Semiautomatic, constant speed wire feeders.

NOTE: Gas-shielded welding requires a Magnum Gun. Gasless welding requires an Innershield Gun.

LN-742 Wire Feeder – A semiautomatic wire feeder with "cold" electrode. Requires K589-1 Remote Control Kit for remote voltage and wire speed control. K857 Remote Voltage Control Kit connects to the RANGER 9 for voltage control at the feeder. Refer to connection instructions later in this section.

Magnum Spool Gun (K487-25) – A lightweight, semiautomatic wire feeder for aluminum welding with argon gas. Has built-in remote wire speed control in the handle. Requires the K488 SG Control Module. Includes 50 feet (15.2 meters) of power cable.

SG Control Module (K488) – Controls wire speed and gas flow. Provides the required control interface between the RANGER 9 and the K487-25 Magnum Spool Gun.

CONNECTION OF LINCOLN ELECTRIC WIRE FEEDERS

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not operate with panels open.
- Disconnect NEGATIVE (-) BATTERY LEAD before servicing.
- Do not touch electrically live parts.

MOVING PARTS can injure.

- Keep guards in place.
- Keep away from moving parts.
- Only qualified personnel should install, use or service this equipment.

CONNECTION OF THE RANGER 9 TO WIRE FEEDERS USING K867 UNIVERSAL ADAPTER (SEE FIGURE C.1)

NOTE: When you use the RANGER 9 with non-Lincoln Electric wire feeders or with certain earlier models of Lincoln wire feeders, you will require the K867 Univeral Adapter. The following discussion and connection diagram explain in general how to make the proper connections.

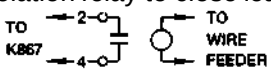
1. Shut the welder off.
2. Connect the electrode cable from the wire feeder to the “ELECTRODE” terminal of the welder. Connect the work cable to the “TO WORK” terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K867 Universal Adapter to the 14 pin amphenol of the RANGER 9 as shown in Figure F.1. Make the proper connections for local or remote control according to Figure C.1 and the following NOTES, indicated on the figure:

   A. These leads are not used for the RANGER 9. Insulate each unused lead individually.

   B. For wire feeders that return a signal for welding output, use an isolation relay to close leads 2 and 4.



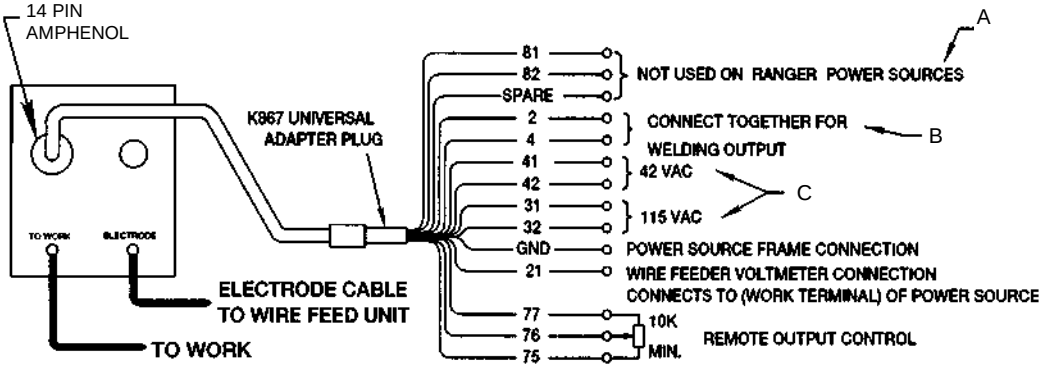
   C. Refer to the OPERATION section of this manual for maximum auxiliary current draw.

4. Set the welder “polarity” switch to the desired polarity, either DC (-) or DC (+).
5. Set the “RANGE” switch to the “WIRE FEED” position.
6. Place the “IDLER” switch in the “HIGH” position.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

FIGURE C.1 – RANGER 9/K867 UNIVERSAL ADAPTER CONNECTION DIAGRAM



7. Place the WELDING TERMINALS switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed at the wire feeder and set the welding voltage with the output "CONTROL" to a CV (constant voltage) position at the welder.

NOTE: If optional remote control is used, place the output control switch in the "CONTROL REMOTE" position.

CONNECTION OF THE LN-25 TO THE RANGER 9 "ACROSS THE ARC" (SEE FIGURE C.2.)

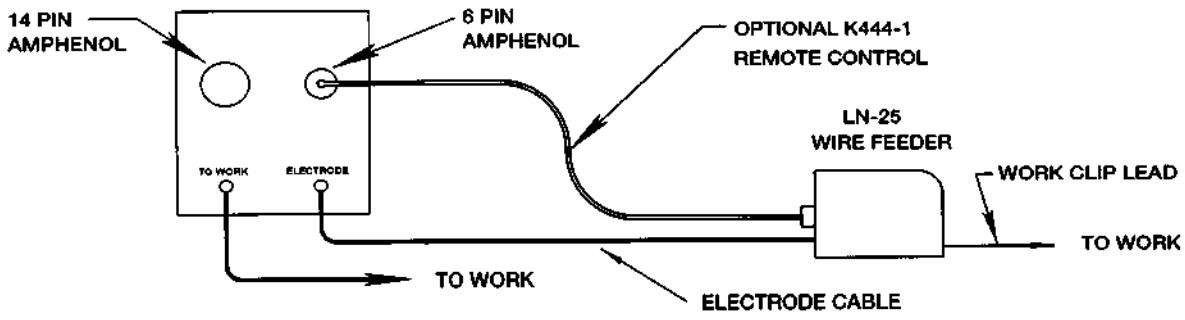
1. Shut the welder off.
2. Connect the electrode cable from the LN-25 to the "ELECTRODE" terminal of the welder. Connect the work cable to the "TO WORK" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Set the welder "polarity" switch to the desired polarity, either DC (-) or DC (+).
4. Set the "RANGE" switch to the "WIRE FEED" position.
5. Attach the single lead from the LN-25 control box to the work using the spring clip on the end of the lead. This is only a control lead — it carries no welding current.
6. Place the "IDLER" switch in the "AUTO" position.
7. Place the WELDING TERMINALS switch in the "ALWAYS ON" position.
8. Adjust wire feed speed at the LN-25 and adjust the welding voltage with the output "CONTROL" at the welder.

NOTE: If optional remote control is used, place the output control switch in the "CONTROL REMOTE" position.

FIGURE C.2 – RANGER 9/LN-25 ACROSS THE ARC CONNECTION DIAGRAM



CONNECTION OF THE LN-25 TO THE RANGER 9 WITH 42 VOLT REMOTE OUTPUT CONTROL MODULE (SEE FIGURE C.3.)

1. Shut the welder off.
2. Connect the electrode cable from the K626-XX Input Cable Assembly to the "ELECTRODE" terminal of the welder and to the LN-25 wire feeder. Connect the work cable to the "TO WORK" terminal of the welder.

   NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the input cable from the K626-XX Input Cable Assembly to the 14 pin amphenol on the RANGER 9 and the input cable plug on the LN-25.
4. Set the welder "polarity" switch to the desired polarity, either DC (-) or DC (+).
5. Set the "RANGE" switch to the "WIRE FEED" position.
6. Place the "IDLER" switch to the "AUTO" or "HIGH" position as desired.

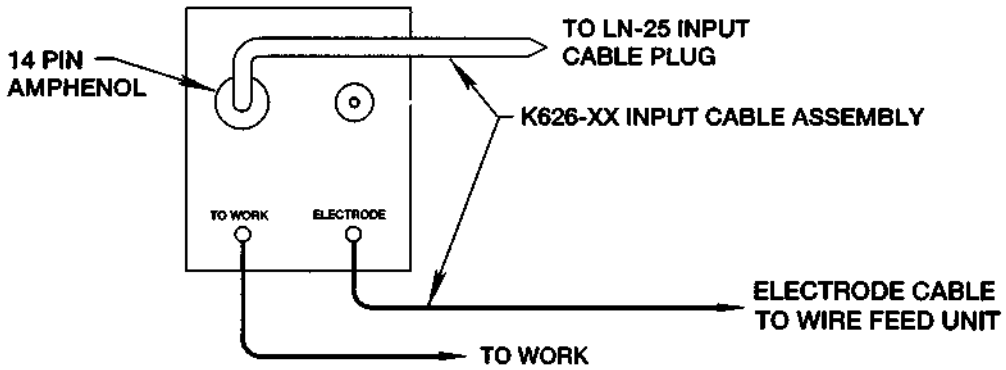
⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

7. Place the WELDING TERMINALS switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed at the LN-25 and set the welding voltage with the output "CONTROL" at a CV (constant voltage) position at the welder.

   NOTE: If optional remote control is used, place the output control switch in the "CONTROL REMOTE" position.

FIGURE C.3
RANGER 9/LN-25 WITH 42 VOLT REMOTE OUTPUT CONTROL MODULE CONNECTION DIAGRAM



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CONNECTION OF THE LN-7 TO THE RANGER 9 USING K584 INPUT CABLE ASSEMBLY (SEE FIGURE C.4.)

NOTE: If your LN-7 comes equipped with a K291 or K404 Input able, refer to CONNECTION OF THE LN-7 Using K867 UNIVERSAL ADAPTER, rather than this discussion, to connect your RANGER 9 for wire feed welding.

1. Shut the welder off.
2. Connect the electrode cable from the K584-XX Input Cable Assembly to the “ELECTRODE” terminal of the welder and to the LN-7 wire feeder. Connect the work cable to the “TO WORK” terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the input cable from the K584-XX Input Cable Assembly to the 14 pin amphenol on the RANGER 9 and the input cable plug on the LN-7.
4. Set the welder “polarity” switch to the desired polarity, either DC (-) or DC (+).
5. Set the “RANGE” switch to the “WIRE FEED” position.
6. Place the “IDLER” switch in the “HIGH” position.

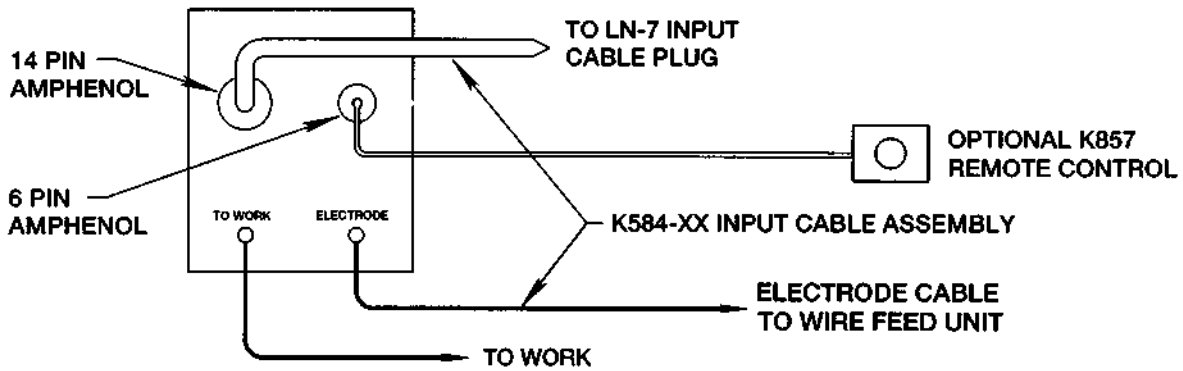
⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

7. Place the WELDING TERMINALS switch in the “REMOTELY CONTROLLED” position.
8. Adjust wire feed speed at the LN-7 and set the welding voltage with the output “CONTROL” at a CV (constant voltage) position at the welder.

NOTE: If optional remote control is used, place the output control switch in the “CONTROL REMOTE” position.

FIGURE C.4
RANGER 9/LN-7 WITH K584 INPUT CABLE ASSEMBLY CONNECTION DIAGRAM



CONNECTION OF THE LN-7 TO THE RANGER 9 USING K867 UNIVERSAL ADAPTER (SEE FIGURE C.5.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-7 to the "ELECTRODE" terminal of the welder. Connect the work cable to the "TO WORK" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K867 Universal Adapter to the LN-7 wire feeder and the 14 pin amphenol of the RANGER 9 as indicated in Figure C.5. Make the proper connections for local or remote control according Figure C.5 and the following NOTES, indicated on the figure:
   A. Insulate each unused lead individually.
   B. Splice the leads and insulate.
4. Set the welder "polarity" switch to the desired polarity, either DC (-) or DC (+).
5. Set the "RANGE" switch to the "WIRE FEED" position.
6. Place the "IDLER" switch in the "HIGH" position.

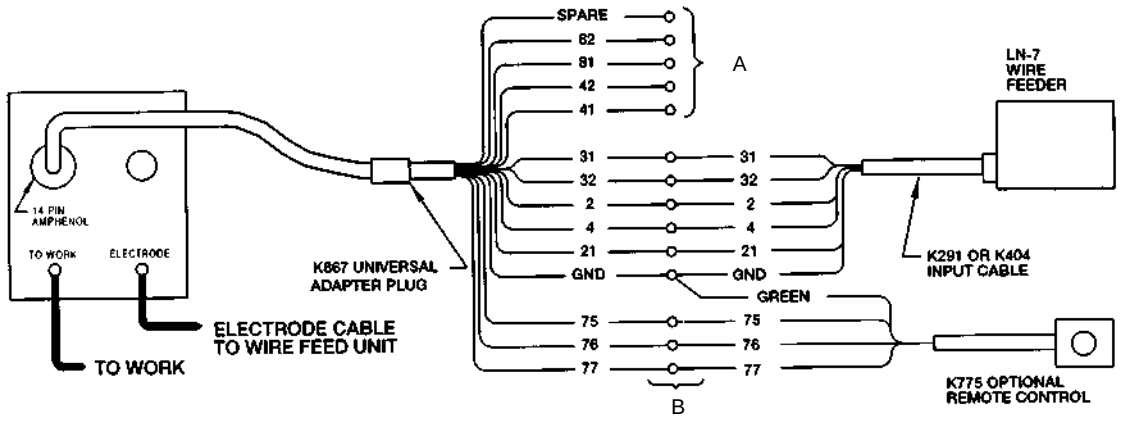
⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

7. Place the WELDING TERMINALS switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed at the LN-7 and set the welding voltage with the output "CONTROL" to a CV (constant voltage) position at the welder.

NOTE: If optional remote control is used, place the output control switch in the "CONTROL REMOTE" position.

FIGURE C.5
RANGER 9/LN-7 WITH K867 ADAPTER CONNECTION DIAGRAM



CONNECTION OF THE LN-8 TO THE RANGER 9 (SEE FIGURE C.6.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-8 to the "ELECTRODE" terminal of the welder. Connect the work cable to the "TO WORK" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K867 Universal adapter to the LN-8 wire feeder and the 14 pin amphenol of the RANGER 9 as indicated in Figure C.6. Make the proper connections for local or remote control according to Figure C.6 and the following NOTES, indicated on the figure:
   A. Insulate each unused lead individually.
   B. Splice the leads and insulate.
4. Set the welder "polarity" switch to the desired polarity, either DC (-) or DC (+).
5. Set the "RANGE" switch to the "WIRE FEED" position.
6. Place the "IDLER" switch in the "˙HIGH" position.

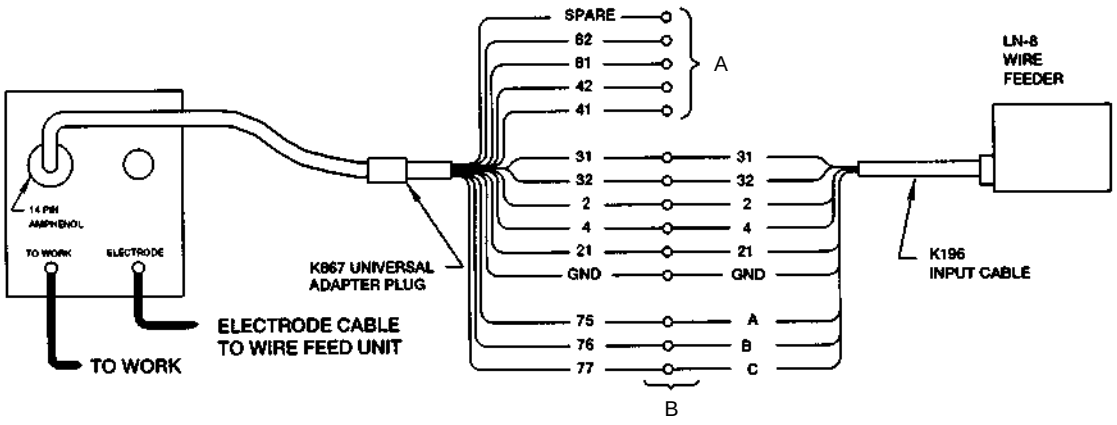
⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

7. Place the WELDING TERMINALS switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed at the LN-8 and set the welding voltage with the output "CONTROL" to a CV (constant voltage) position at the welder.

NOTE: If optional remote control is ued, place the output control switch in the "CONTROL REMOTE" position.

FIGURE C.6
RANGER 9/LN-8 CONNECTION DIAGRAM



CONNECTION OF THE LN-742 TO THE RANGER 9 (SEE FIGURE C.7.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-742 to the “ELECTRODE” terminal of the welder. Connect the work cable to the “TO WORK” terminal of hte welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K592 Control Cable to the 14 pin amphenol on the RANGER 9 and the input cable plug on the LN-742.
4. Set the welder “polarity” switch to the desired polarity, either DC (-) or DC (+).
5. Set the “RANGE” switch to the “WIRE FEED” position.
6. Place the “IDLER” switch in the “AUTO” or “HIGH” position as desired.

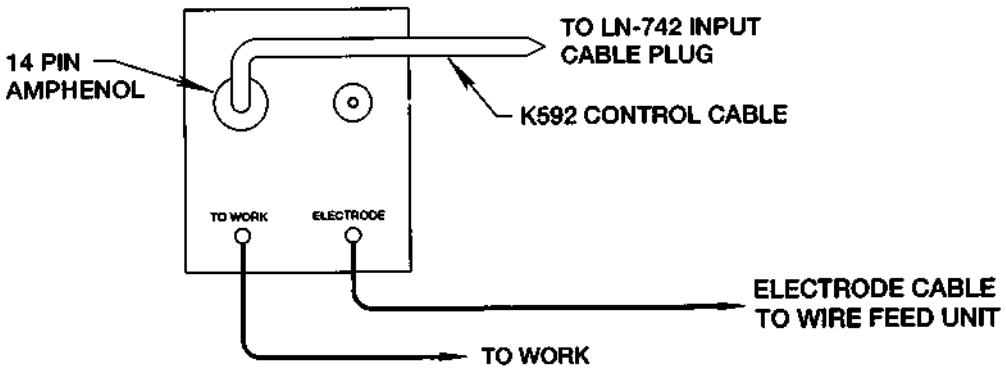
⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary volage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

7. Place the WELDING TERMINALS switch in the “REMOTELY CONTROLLED” position.
8. Adjust wire feed speed at the LN-742 and set the welding voltage with the output “CONTROL” to a CV (constant voltage) position at the welder.

NOTE: If optional remote control is used, place the output control switch in the “CONTROL REMOTE” position.

FIGURE C.7
RANGER 9/LN-742 CONNECTION DIAGRAM



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CONNECTION OF THE K488 SG CONTROL MODULE AND K487 MAGNUM SPOOL GUN TO THE RANGER 9 (SEE FIGURE C.8.)

1. Shut the welder off.
2. Connect the electrode cable from the SG Control Module to the “ELECTRODE” terminal of the welder. Connect the work cable to the “TO WORK” terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K691-10 Input Cable to the SG Control Module and the 14 pin amphenol of the RANGER 9 as indicated in Figure C.8.
4. Set the slide switch on the SG Control Module to the “Lincoln” position.

⚠ CAUTION

Be sure this switch is set to the “Lincoln” (contact closure) position before attempting to operate the SG Control Module. Incorrect switch position could result in damage to the SG Control Module and/or the RANGER 9.

5. Set the welder “polarity” switch to the desired polarity, either DC (-) or DC (+).
6. Set the “RANGE” switch to the “WIRE FEED” position.
7. Place the “IDLER” switch in the “HIGH” position.

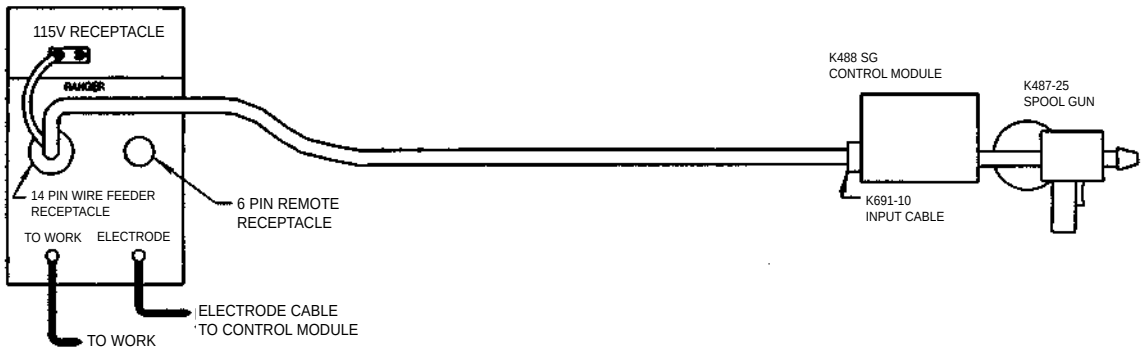
⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory — do not adjust above RPM specifications listed in this manual.

8. Place the WELDING TERMINALS switch in the “REMOTELY CONTROLLED” position.
9. Adjust wire feed speed at the SG Control Module and set the welding voltage with the output “CONTROL” to a CV (constant voltage) position at the welder.

NOTE: If optional remote control is used, place the output control switch in the “CONTROL REMOTE” position.

FIGURE C.8
RANGER 9 AND 10LX/K691-10/K488/K487 SPOOL GUN CONNECTION DIAGRAM



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SAFETY PRECAUTIONS

⚠ WARNING

- Have qualified personnel do all maintenance and troubleshooting work.
- Turn the engine off before working inside the machine.
- Remove guards only when necessary to perform maintenance and replace them when the maintenance requiring their removal is complete.
- If guards are missing from the machine, get replacements from a Lincoln Distributor. See the EXPLODED VIEW AND PARTS LIST at the back of this manual.

Read the Safety Precautions in the front of this manual and in the instruction manual for the Onan gasoline engine used with your machine before working on the RANGER 9.

Keep all equipment safety guards, covers, and devices in position and in good repair. Keep your hands, hair, clothing, and tools away from the recoil housing, fans, and all other moving parts when starting, operating, or repairing this machine.

ROUTINE AND PERIODIC MAINTENANCE

ENGINE MAINTENANCE

⚠ CAUTION

To prevent the engine from accidentally starting, disconnect the spark plug lead before servicing the engine.

See Table D.2 for a summary of maintenance intervals for the items listed below. Follow either the hourly or the calendar intervals, whichever come first. More frequent service may be required, depending on your specific application and operating conditions. Table D.3 shows engine maintenance replacement parts and numbers.

OIL: Check the oil level after every 5 hours of operation or daily. BE SURE TO MAINTAIN THE OIL LEVEL. Change the oil the first time after 25 hours of operation. Then, under normal operating conditions, change the oil as specified in Table D.3. If the engine is operated under heavy load or in high ambient temperatures, change the oil more frequently.

CHANGE THE OIL

Change the oil, while the engine is still warm, as follows:

1. Drain the oil from the drain plug located on the engine bottom, as shown in Figure D.1. For the RANGER 9, a short pipe nipple has been installed to extend the drain plug access for easier serviceability.
2. Replace the cap on the drain extension and tighten it securely.
3. Remove the oil fill cap and add oil until the level reaches the full mark on the dipstick. Use high quality detergent oil of API service class SF, SF/CC, or SF/CD . See Table D.1 for recommended viscosity grades. Straight weight oils are recommended for severe duty use and at temperatures above 32°F (0°C) for minimum oil consumption. Always check the level with the dipstick before adding more oil.
4. Reinstall the oil fill cap and dipstick.

TABLE D.1

RECOMMENDED OIL VISCOSITY GRADES

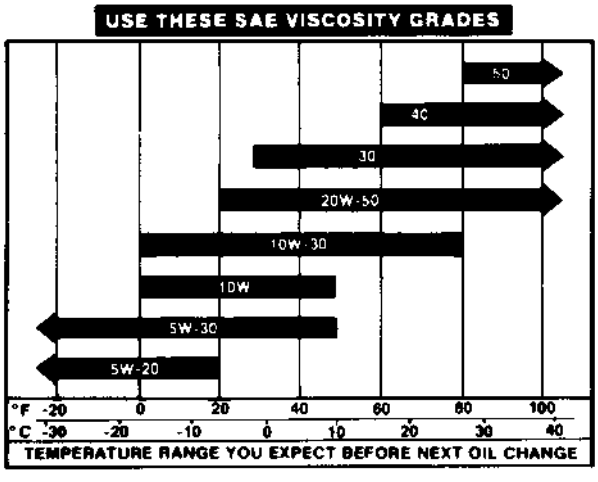

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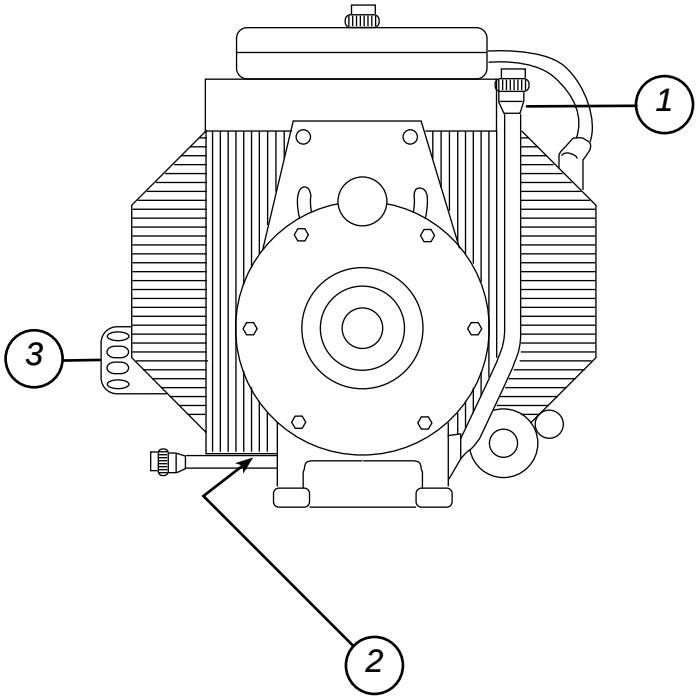
FIGURE D.1 – OIL DRAIN AND REFILL LOCATION



1. DIPSTICK/OIL FILL
2. OIL DRAIN PLUG
3. OIL FILTER

CHANGE THE OIL FILTER

Change the oil filter the first time after 25 hours of operation. Then, under normal operating conditions, change the oil filter after every other oil change. If the engine is operated under heavy load or in high ambient temperatures, change the oil filter more frequently. See Table D.3 for recommended maintenance intervals.

Change the oil filter as follows:

1. Drain the oil from the engine and allow the oil filter to drain.
2. Remove the old filter (spin it off) and discard it. Wipe off the filter mounting surface and adapter.
3. Apply a thin coat of new oil to the rubber gasket on the new oil filter.
4. Spin the new filter onto the mounting adapter until the gasket just touches the mounting surface, then turn it down another 1/2 to 3/4 turn. Do not overtighten the new filter.
5. Refill the engine with the proper amount and type of oil as described in the Change the Oil section, above. Start the engine and check for leaks around the filter element. Correct any leaks (usually by retightening the filter, but only enough to stop leaks) before placing the RANGER 9 back in service.
6. If there are no leaks, stop the engine and recheck the oil level. If necessary, add oil to bring the level up to the FULL mark, but do not overfill.

FUEL: At the end of each day's use, refill the fuel tank to minimize moisture condensation and dirt contamination in the fuel line. Do not overfill; leave room for the fuel to expand.

Use only fresh, **unleaded** gasoline with octane rating 87 or higher. Gasoline/alcohol blends are approved for use with your engine as long as the blend does not exceed 10% ethyl alcohol by volume. Other gasoline/alcohol blends are not approved, and their use may damage fuel system and engine parts.

FUEL FILTER: Your engine may be equipped with an in-line fuel filter. Inspect the fuel filter periodically and replace it if it appears dirty.

MAINTENANCE

AIR CLEANER: Your air cleaner may have only the paper element, or it may have the cartridge and a foam precleaner. If it has the precleaner, service the element every 50 hours and the precleaner every 25 hours. If the air cleaner doesn't have the precleaner, service the element every 25 hours. Under dusty conditions, service more often. Check the air cleaner every day or before starting the engine for any buildup of dirt, debris, or loose or damaged components.

⚠ CAUTION

DO NOT OIL THE ELEMENT OR USE PRESSURIZED AIR TO CLEAN THE ELEMENT. DO NOT WASH THE ELEMENT.

Remove the air cleaner cover:

1. Remove the cover nut, cover, element cover nut and element cover, Figure D.2.
2. Carefully remove the foam precleaner, if equipped, from the element.

To service the precleaner:

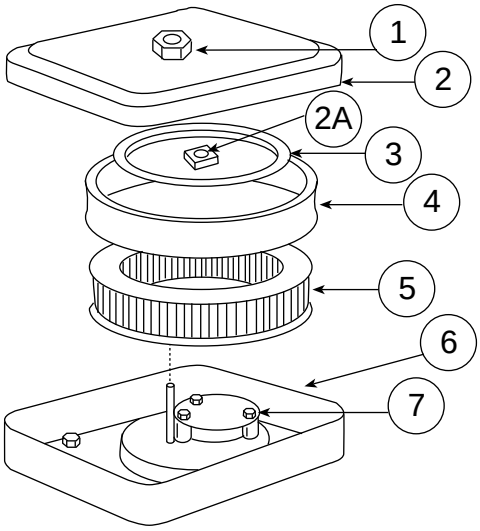
1. Wash in liquid detergent and water.
2. Squeeze dry in a clean cloth.
3. Saturate in clean engine oil.
4. Squeeze in a clean, absorbent cloth to remove all excess oil.

To service the element:

1. Tap gently on a clean surface.
2. Inspect all air cleaner components, including cover and base components, for wear or damage. Check that all sealing surfaces are in good condition.
3. Replace with a new element if the old one is very dirty, bent, or otherwise damaged.

Carefully place the precleaner back over the element and reinstall and secure the air cleaner cover components.

FIGURE D.2 - AIR CLEANER COMPONENTS, ONAN ENGINE



1. COVER NUT
2. COVER
2A. ELEMENT COVER NUT
3. ELEMENT COVER
4. ELEMENT PRECLEANER
5. ELEMENT
6. BASE
7. AIR DEFLECTOR PLATE

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CRANKCASE BREATHER: The Onan engine is equipped with a crankcase breather that prevents pressure from building up inside the crankcase, prevents moisture contamination from moisture, gasoline vapors, or combustion vapors. If the breather valve becomes sticky, it can cause oil leaks, oil consumption, rough idle, reduced power, and sludge and varnish buildup in the engine.

The breather cannot be serviced. However, it should be periodically inspected and replaced if cracked or broken, or if the crankcase becomes pressurized. Evidence of high pressure includes oil leaks at the seals or excessive oil in the air cleaner housing.

CLEAN ENGINE: Remove dirt and debris with a cloth or brush. Do not clean with a forceful spray of water. Water might contaminate the fuel system.

⚠ CAUTION

Periodically clean the muffler area to remove combustible debris.

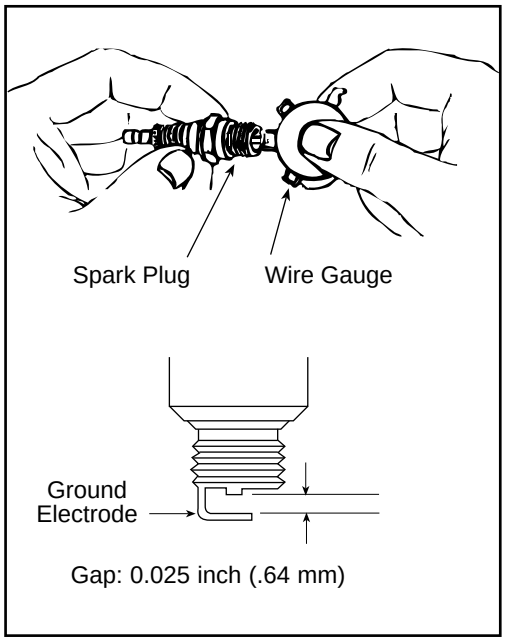
CLEAN AIR INTAKE/COOLING AREAS: To ensure proper cooling, make sure the grass screen, cooling fins, and other external engine surfaces are always kept clean. This will prevent overspeeding, overheating, and engine damage due to dirt or debris buildup. Every 50 operating hours or as often as necessary, remove the blower housing and other cooling shrouds. Clean the cooling fins and external surfaces as necessary. Make sure to replace all the cooling shrouds. Running the engine without the cooling shrouds will cause damage to the engine from overheating.

CLEAN OR REPLACE SPARK PLUGS: Clean or replace the spark plugs after every 500 hours of operation as follows.

1. Before removing the plugs, clean the base area to keep dirt from falling into the engine through the plug hole.
2. Remove and inspect the plugs. Plugs showing signs of fouling or electrode wear should be replaced. Do not blast the spark plugs clean with an abrasive cleaning device. Clean the plugs by scraping or by using a wire brush. Wash the plugs with a commercial solvent.
3. After cleaning or when installing a new spark plug, set the terminal gap with a feeler gauge. See Figure D.3.

Gap Specifications: 0.025 inch (.64 mm)

FIGURE D.3 - SET SPARK PLUG GAP



CLEAN SPARK ARRESTER SCREEN: If the muffler has the optional spark arrester, remove it every 50 hours or once a year, whichever comes first, and inspect it. Clean the arrester. Replace it if you find any damage.

REMOVE COMBUSTION DEPOSITS: Combustion deposits (carbon) can form on the cylinder, cylinder head, top of the piston, and around the valves over time, depending on engine loading conditions, type of fuel used, and other factors that affect engine performance. Consult your local Onan engine distributor for recommended cleaning intervals and procedures.

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TABLE D.2
ONAN ENGINE MAINTENANCE SCHEDULE

FREQUENCY	MAINTENANCE REQUIRED
Daily or Before Starting Engine	• Fill fuel tank. • Check oil level. • Check air cleaner for dirty[2], loose, or damaged parts. • Check air intake and cooling areas, clean as necessary[2].
Every 25 Hours	• Service precleaner element[2].
Every 50 Hours	• Service air cleaner element[2]. • Change oil[1].
Every 100 Hours	• Check spark plug condition and gap. • Remove cooling shrouds and clean cooling areas[2]. • Change oil filter.

Note 1: Change oil every 25 hours when operating under heavy load in high ambient temperatures.
Note 2: Clean more often under dusty conditions or when airborne debris is present.

TABLE D.3
ENGINE MAINTENANCE PARTS

Part	Part Number - Onan
Oil Filter	Onan 122-0645 FRAM PH3614
Fuel Filter	Onan 149-2005 FRAM G1
Air Cleaner Element	Onan 140-2628-01 FRAM CA140PL
Air Cleaner Precleaner	Onan 140-1496
Spark Plugs	Onan 167-0263 Champion® RS14YC (.025” gap - .64 mm)

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BATTERY MAINTENANCE

⚠ WARNING

GASES FROM BATTERY can explode.

- Keep sparks, flame, and cigarettes away from battery.

To prevent EXPLOSION when:

- INSTALLING A NEW BATTERY - Disconnect the negative cable from the old battery first and connect to the new battery last.

- CONNECTING A BATTERY CHARGER - Remove the battery from the welder by disconnecting the negative cable first, then the positive cable and battery clamp. When reinstalling, connect the negative cable last. Keep the area well ventilated.
- USING A BOOSTER - Connect the positive lead to the battery first, then connect the negative lead to the engine foot.

BATTERY ACID CAN BURN EYES AND SKIN.

- Wear gloves and eye protection and be careful when working near a battery. Follow the instructions printed on the battery.

CLEANING THE BATTERY

Keep the battery clean by wiping it with a damp cloth when dirty. If the terminals appear corroded, disconnect the battery cables and wash the terminals with an ammonia solution or a solution of 1/4 pound (0.113 kg) of baking soda and 1 quart (0.946 l) of water. Be sure the battery vent plugs (if equipped) are tight so that none of the solution enters the cells.

After cleaning, flush the outside of the battery, the battery compartment, and surrounding areas with clear water. Coat the battery terminals lightly with petroleum jelly or a non-conductive grease to retard corrosion.

Keep the battery clean and dry. Moisture accumulation on the battery can lead to more rapid discharge and early battery failure.

CHECKING SPECIFIC GRAVITY

Check each battery cell with a hydrometer. A fully charged battery will have a specific gravity of 1.260. Charge the battery if the reading is below 1.215.

NOTE: Correct the specific gravity reading by adding four gravity points (0.004) for every five degrees the electrolyte temperature is above 80 degrees F (27 degrees (C). Subtract four gravity points (9.004) for every five degrees the electrolyte temperature is below 80 degrees F (27 degrees C).

CHECKING ELECTROLYTE LEVEL

If battery cells are low, fill them to the neck of the filler hole with distilled water and recharge. If one cell is low, check for leaks.

CHARGING THE BATTERY

When you charge, jump, replace, or otherwise connect battery cables to the battery, be sure the polarity is correct. Improper polarity can damage the charging circuit. The RANGER 9 positive (+) battery terminal has a red terminal cover.

If you need to charge the battery with an external charger, disconnect the negative cable first, then the positive cable before you attach the charger leads. After the battery is charged, reconnect the positive battery cable first and the negative cable last. Failure to do so can result in damage to the internal charger components.

Follow the instructions of the battery charger manufacturer for proper charger settings and charging time.

WELDER/GENERATOR MAINTENANCE

STORAGE: Store the RANGER 9 in clean, dry, protected areas.

CLEANING: Blow out the generator and controls periodically with low pressure air. Do this at least once a week in particularly dirty areas.

BRUSH REMOVAL AND REPLACEMENT: It's normal for the brushes and slip rings to wear and darken slightly. Inspect the brushes when a generator overhaul is necessary. Remove the brushes and clean the slip rings with fine emery paper. Refer to the "Brush Removal and Replacement" procedure in the ***Trouble-shooting and Repair*** section of this manual.

⚠ CAUTION

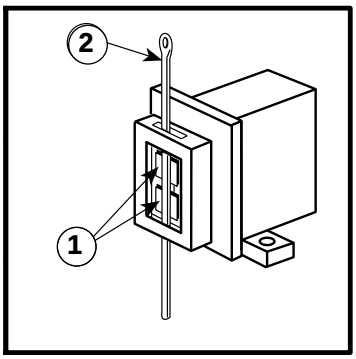
Do not attempt to polish slip rings while the engine is running.

To reinstall the brushes, press them upward and slide a cable tie or wooden stick through the brush holder tabs. See Figure D.4. Install the brush holder into position and secure with the screws previously removed. Remove the cable tie or wooden stick and the brushes will seat onto the slip rings.

RECEPTACLES: Keep the electrical receptacles in good condition. Remove any dirt, oil, or other debris from their surfaces and holes.

CABLE CONNECTIONS: Check the welding cable connections at the weld output terminals often. Be sure that the connections are always firm.

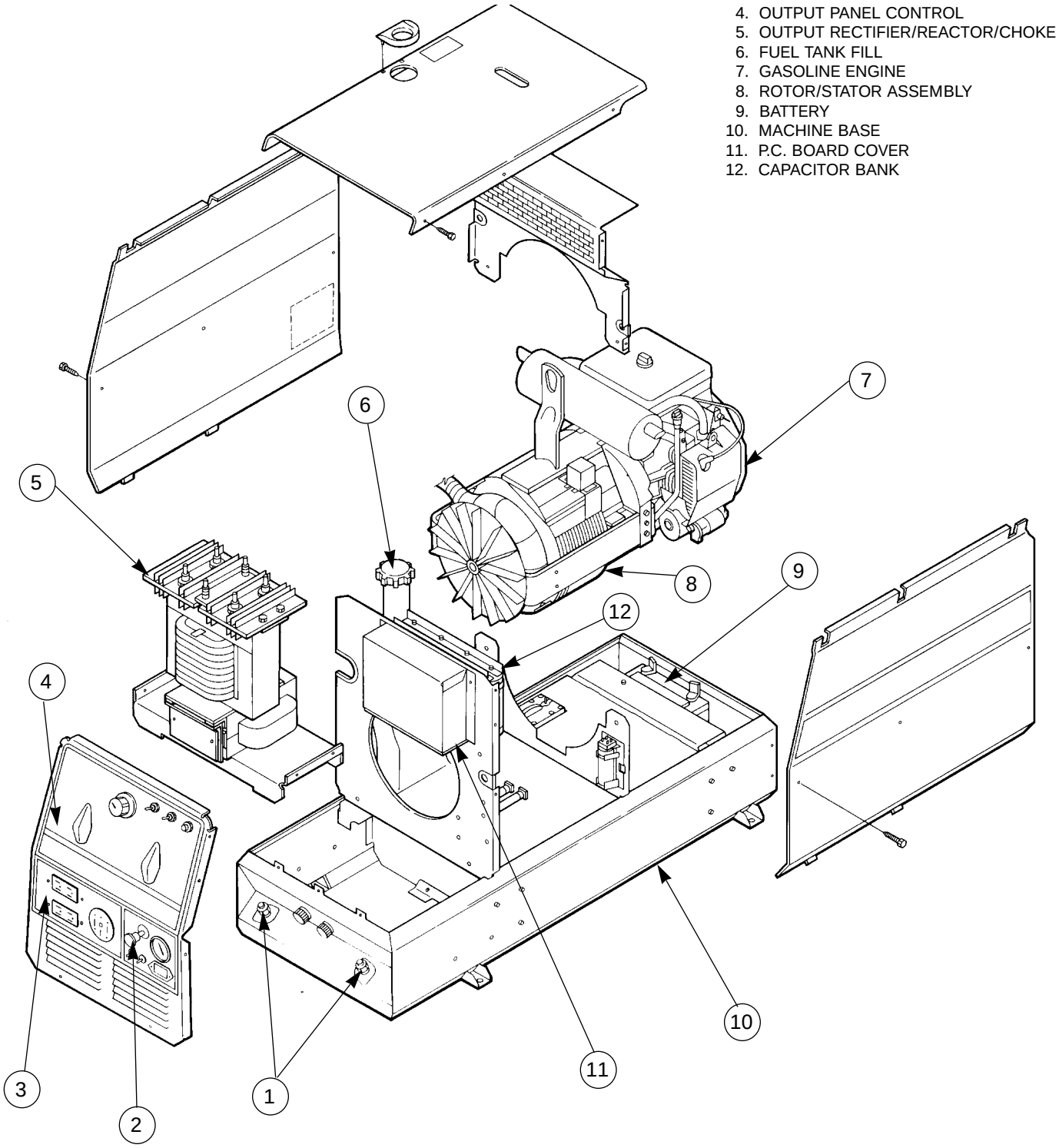
FIGURE D.4 - BRUSH REMOVAL AND REPLACEMENT



1. BRUSHES
2. CABLE TIE

FIGURE D.6 - MAJOR COMPONENT LOCATIONS

1. OUTPUT TERMINALS (LOCATION)
2. ENGINE CONTROLS
3. AUXILIARY POWER RECEPTACLES
4. OUTPUT PANEL CONTROL
5. OUTPUT RECTIFIER/REACTOR/CHOKE
6. FUEL TANK FILL
7. GASOLINE ENGINE
8. ROTOR/STATOR ASSEMBLY
9. BATTERY
10. MACHINE BASE
11. P.C. BOARD COVER
12. CAPACITOR BANK



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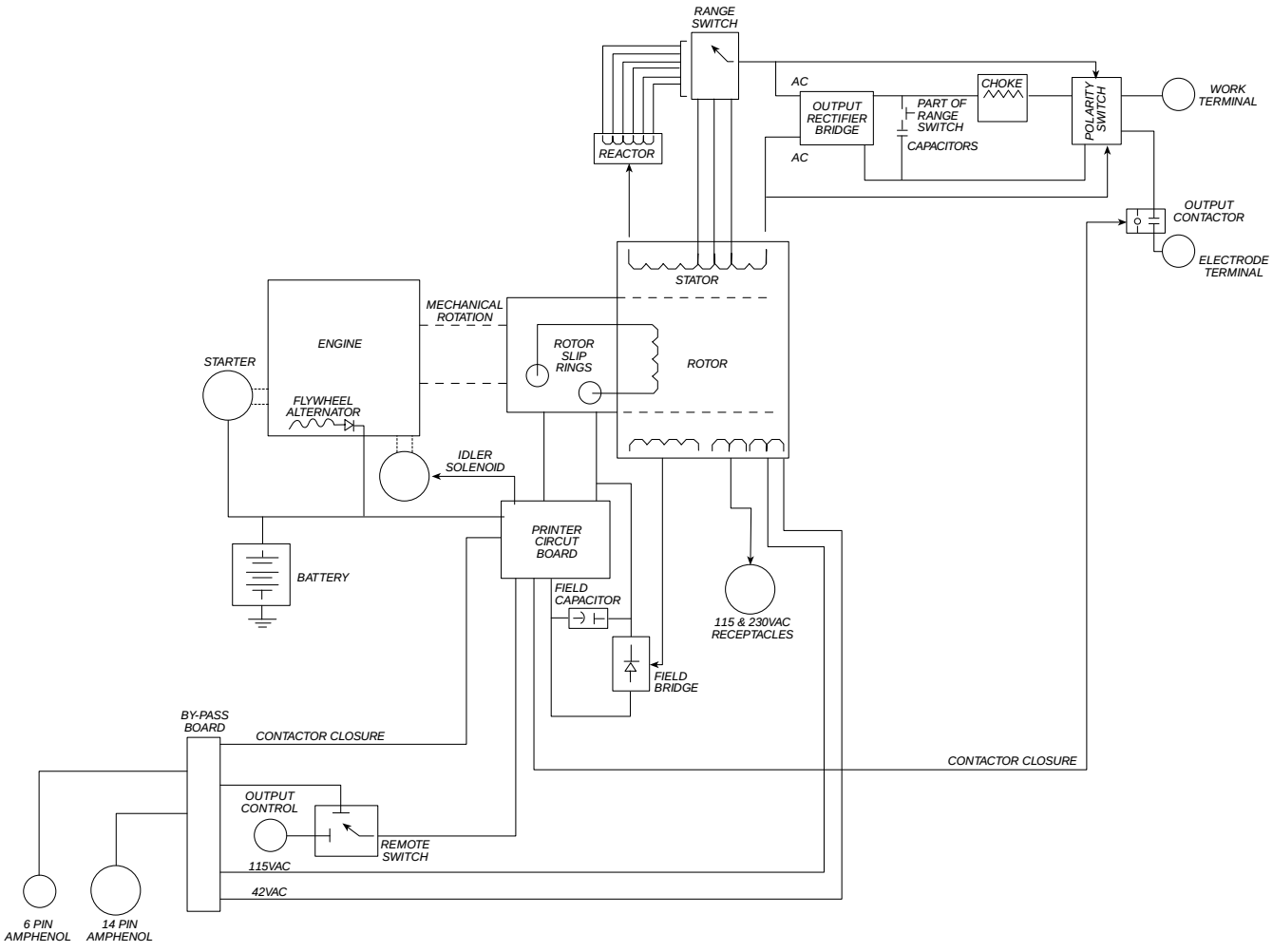
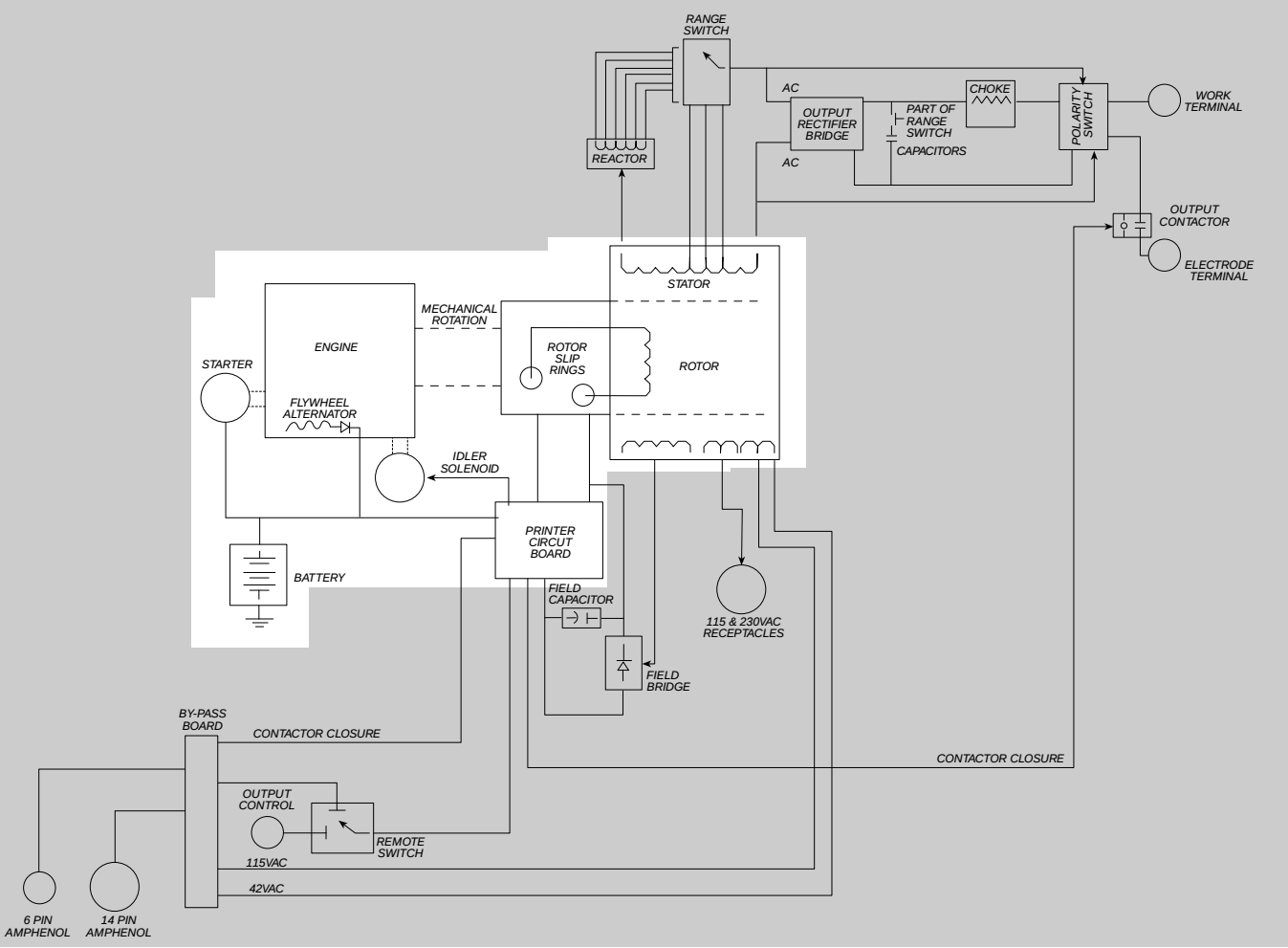


FIGURE E.1 – RANGER 9 BLOCK LOGIC DIAGRAM

THEORY OF OPERATION

FIGURE E.2 – BATTERY, STARTER, ENGINE, ROTOR, STATOR AND IDLER SOLENOID



BATTERY, STARTER, ENGINE, ROTOR, STATOR, AND IDLER SOLENOID

The 12VDC battery powers the starter motor. When the engine is started and running, the battery circuit voltage is fed, through the printed circuit board, to the rotating field coil in the rotor via a brush and slip ring configuration. This excitation ("flashing") voltage magnetizes the rotor lamination. The rotor is mechanically coupled to the engine. This rotating magnet induces a voltage in the stationary windings of the main alternator (stator). Four separate and isolated windings are incorporated in the stator lamination assembly. Each winding set has a different number of turns producing different magnitudes of AC output voltages. The four windings are the weld winding, the auxiliary power winding, the field feedback winding, and the auxiliary power winding for wire feeders. The field feedback winding provides rotor current during machine operation. The output of the RANGER 9 is dependent on two criteria: the engine RPM and the amount of current in the rotor winding.

The flywheel alternator, located on the engine, supplies "charging" current for the battery circuit. The battery circuit provides power for the printed circuit board and also for the idler solenoid. The idler solenoid is mechanically connected to the engine throttle linkage. If no current is being drawn from the RANGER 9, the printed circuit board activates the idler solenoid, which then brings the engine to a low idle state. When output current is sensed, either weld or auxiliary, the printed circuit board deactivates the idler solenoid, and the engine returns to high RPM.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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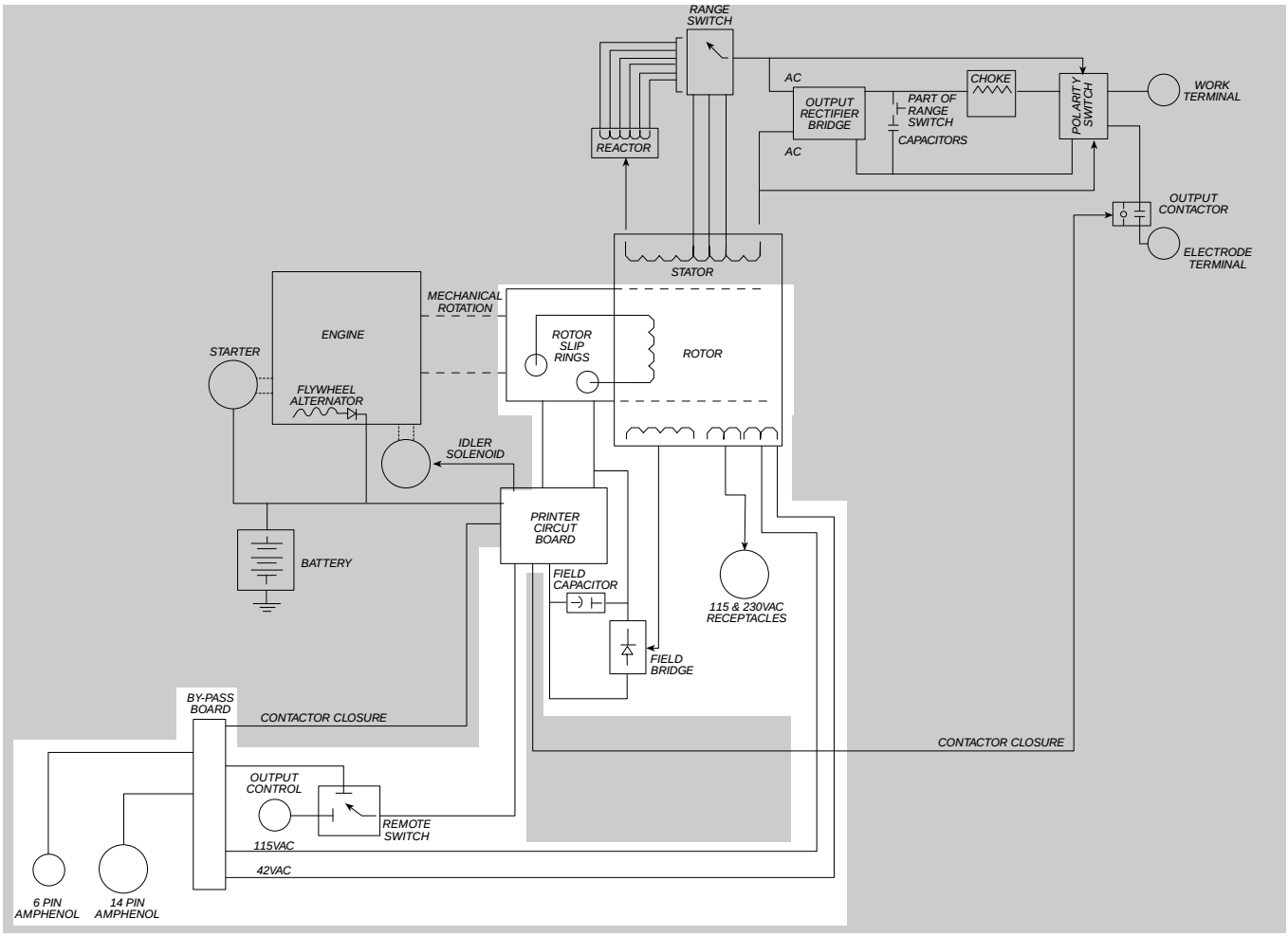
FIGURE E.3 – ROTOR FIELD FEEDBACK, AUXILIARY, AND WIRE FEEDER POWER



ROTOR FIELD FEEDBACK, AUXILIARY, AND WIRE FEEDER POWER

The AC voltage developed in the field winding is fed to the full wave field bridge. The DC output of the bridge is filtered by the field capacitor and controlled by the printed circuit board according to the output control setting. This filtered and controlled voltage is fed to the rotor winding via the brush and slip ring configuration. As the feedback voltage is increased or decreased, the outputs of the weld and auxiliary windings are increased or decreased.

When full field voltage is applied to the rotor and the engine is running at high speed (3700 RPM), a 230 AC voltage is developed in the stator auxiliary winding. This winding is tapped to provide 115 VAC. The two voltages (115 VAC and 230 VAC), are connected to the appropriate receptacles and offer 9000 watts (total) of AC power.

The auxiliary wire feeder winding offers 115VAC and is tapped to also provide 42VAC. The current draw from this winding should be limited to 8 amps. These voltages and remote control signals are fed through the by-pass (filter) board to the amphenol receptacles.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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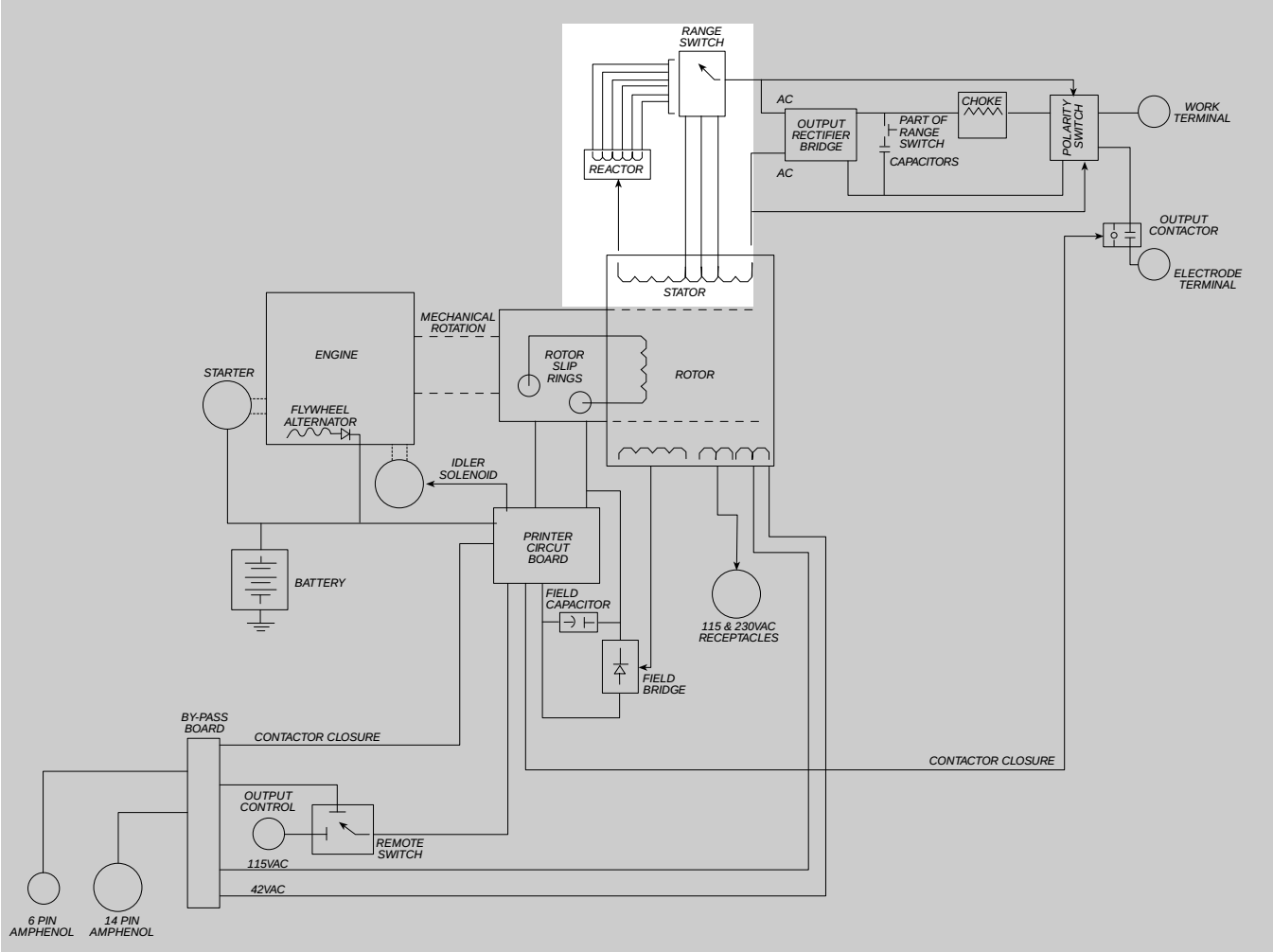
FIGURE E.4 – WELD WINDING, REACTOR, AND RANGE SWITCH



WELD WINDING, REACTOR, AND RANGE SWITCH

The stator weld winding is connected to the reactor and range switch. The inductance in the reactor offers an impedance to current flow. The reactor coil is tapped at various points. As the range switch is rotated, different amounts of reactor coil are brought into the current path. As more turns of reactor are brought into the circuit, the more impedance there is to current flow. Simply stated, the more reactor in the circuit, the lower the welding current.

If a constant voltage is desired for wire feeding, then the reactor is bypassed and the range switch is connected to one of three taps on the stator weld winding to provide a lower but “stiffer” output voltage.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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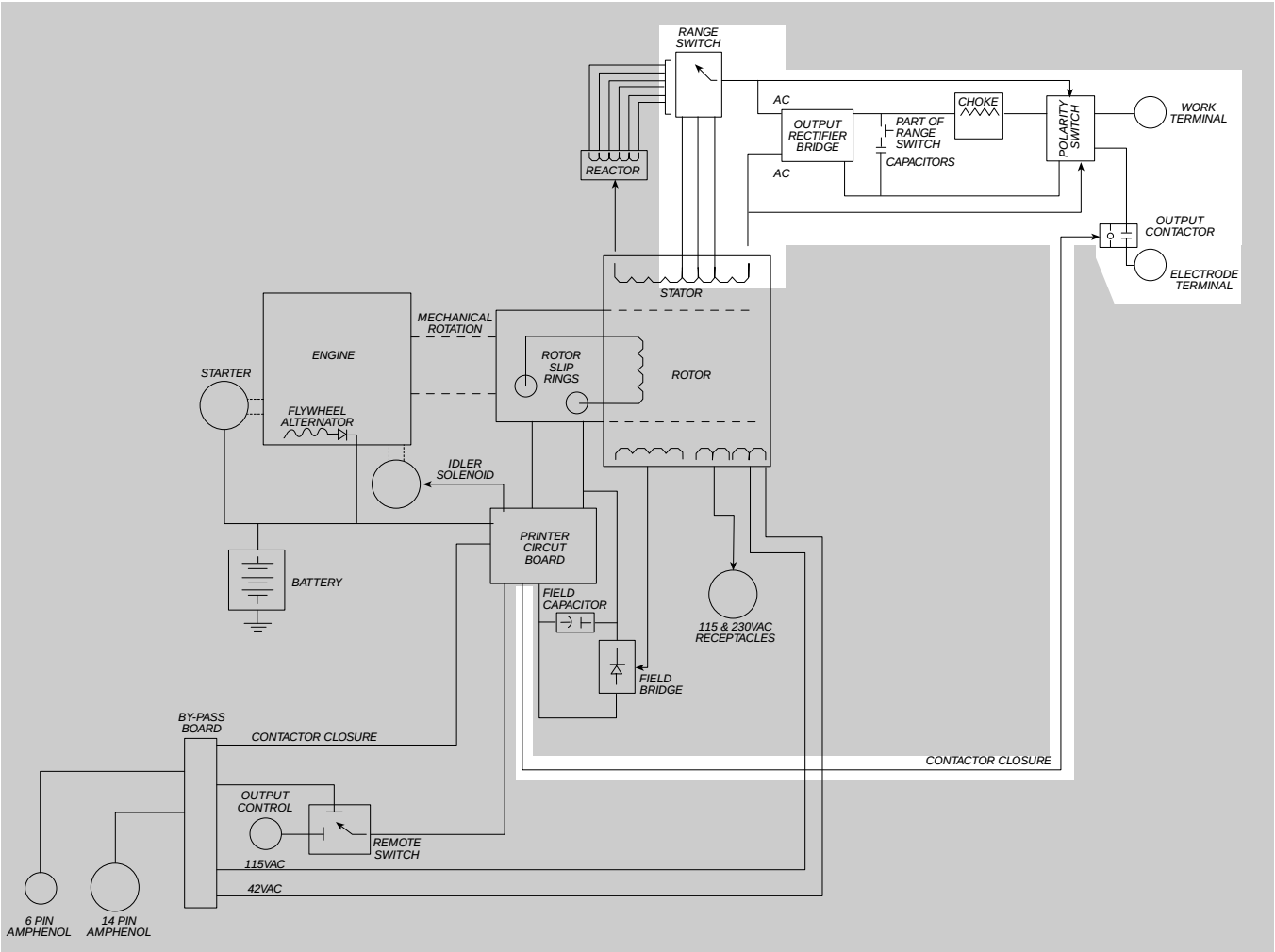
FIGURE E.5
OUTPUT BRIDGE, CAPACITOR, CHOKE, POLARITY SWITCH, CONTACTOR AND OUTPUT TERMINALS



OUTPUT BRIDGE, CHOKE, POLARITY SWITCH, AND OUTPUT TERMINALS

The AC voltage developed in the stator weld winding is delivered, through the reactor and range switch, to the output bridge and polarity switch. Depending upon the setting of the polarity switch, either AC voltage or DC voltage is delivered through the output contactor, which is activated by the printed circuit board, to the output terminals. If AC output is selected, then the current path is from the stator weld winding through the reactor, range switch, polarity switch and output contactor to the output terminals. If a DC output is called for, then the current path is through the output bridge, where the AC voltage is rectified to a DC voltage, and then to the choke, where the DC output is filtered. The filtered DC current path is through the polarity switch and output contactor and then on to the output terminals.

If a CV (constant voltage) mode is desired, the reactor is passed by. The range switch applies a lower AC voltage to the rectifier bridge. The DC output of the bridge is filtered and “stiffened” by the capacitors. This lower but “stiffer” DC output is passed through the choke, polarity switch, and contactor and then on to the output terminals.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into three main categories: Output Problems, Engine Problems, and Welding Problems.

Step 2. PERFORM EXTERNAL TESTS. The second column, labeled "POSSIBLE AREAS OF MISADJUSTMENT(S)", lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

Step 3. PERFORM COMPONENT TESTS. The last column, labeled "Recommended Course of Action" lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

TROUBLESHOOTING & REPAIR

PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING

ELECTRIC SHOCK can kill.

Have an electrician install and service this equipment. Turn the machine OFF before working on equipment. Do not touch electrically hot parts.

Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

ATTENTION
Static-Sensitive Devices
Handle only at Static-Safe Workstations

Reusable Container
Do Not Destroy

PC Board can be damaged by static electricity.

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.
- Remove the PC Board from the static-shielding bag and place it directly into the equipment. Don't set the PC Board on or near paper, plastic or cloth which could have a static charge. If the PC Board can't be installed immediately, put it back in the static-shielding bag.
- If the PC Board uses protective shorting jumpers, don't remove them until installation is complete.
- If you return a PC Board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
   a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
   b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

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detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident.	1. Contact your local Lincoln Authorized Field Service Facility.	1. Contact The Lincoln Electric Service Dept. (216) 383-2531 or 1-800-833-9353 (WELD).
No weld output and no auxiliary power. Engine operates normally.	1. Make sure the REMOTE switch (S4) is in the proper position – "MACHINE CONTROL" if a remote control unit is NOT connected to the machine. 2. Check the brushes for wear and proper contact to the rotor slip rings.	1. Perform the ***Rotor Voltage Test***. 2. If the Rotor Voltage Test is normal, then perform the Rotor Resistance Test. 3. If the Rotor Voltage Test is NOT normal, perform the Auxiliary and Field winding Voltage Test. Then check the field diode bridge (D2), the field capacitor (C1), and the Output Control (R3). Replace if necessary. If the field bridge, field capacitor and Output Control are good, then the printed circuit board may be faulty. Replace.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No weld output, the auxiliary power (230-115VAC) is operating normally. Engine operates normally.	1. With the WELDING TERMINAL switch in the "ALWAYS ON" position, check the open circuit voltage (OCV) at the welder output terminals. Normal maximum is 73 to 80VAC. Normal DC maximum is 65 to 75VDC. If the OCV is OK, then proceed to Step #2. If the OCV is NOT present at the welder output terminals, contact your local Lincoln Authorized Field Service Facility. 2. Check the welding cables, clamps, and electrode holder for loose or broken connections.	1. Make sure the output contactor is being activated. Also make sure there is continuity (zero ohms) through the contactor contacts. 2. Disconnect lead W1 from the output bridge (D1) and check for the presence of 80VAC from lead W1 to lead W2 on the main stator. See Wiring Diagram. If the AC voltage is NOT present, the winding in the stator may be faulty. Check the winding for continuity, and test to be sure it is NOT grounded to the stator iron. Replace if necessary. If the correct AC voltage is present, proceed to step #3. 3. Check the reactor, Range Switch (S2), and associated wiring for loose or faulty connections. Check the reactor winding for continuity and test to be sure it is NOT grounded to the reactor iron. 4. Check the choke (L1), Polarity Switch (S1), and associated wires for loose or faulty connections. Check the choke winding for continuity and test to be sure it is NOT grounded to the choke iron. 5. Check the weld output terminals and associated wires for loose or faulty connections. 6. Perform the ***Output Rectifier Bridge Test.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No auxiliary power at receptacles – welding output is normal – engine runs normally.	1. If the machine is equipped with circuit breakers, check circuit breakers, CB2 through CB7. Reset if tripped. 2. Make sure the Output Control (R3) is set at the maximum position. 3. Check for a loose or faulty plug(s) at the power receptacle(s).	1. Check the auxiliary power receptacles and associated wires for loose or faulty connections. 2. Perform the ***Auxiliary and Field Winding Voltage Test.*** 3. If the machine is equipped with circuit breakers, check for faulty breakers and loose or faulty connections on associated wiring.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Machine has low welding output and low auxiliary output.	1. Make sure the REMOTE switch is in the proper position – "MACHINE CONTROL" if a remote control unit is NOT connected to the machine. 2. The brushes may be worn. Contact your local Lincoln Authorized Service Facility. 3. The Engine RPM may be low.	1. If the engine HIGH IDLE RPM is low, then perform the ***Throttle Adjustment Test.*** 2. Perform the ***Rotor Voltage Test***. 3. If the rotor voltage is low, the field capacitor (C1) or the field bridge (D2) may be faulty. Test and replace if necessary. 4. Check the Output Control potentiometer. Normal resistance is 10,000 ohms. Also check associated wiring for loose or faulty connections. 5. The rotor may be faulty. Perform the ***Rotor Resistance Test.*** 6. The printed circuit board may be faulty. Replace. 7. If the engine HIGH IDLE RPM IS OK, then the engine may have lost horsepower and be in need of major repair.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No DC welding output. AC welding output and auxiliary power are normal.	1. Make sure the Polarity switch (S1) is in the proper position and is "seated" correctly. 2. Make sure the electrode and polarity are correct for the process being used.	1. Perform the ***Output Rectifier Bridge Test.*** 2. Check the choke (L1), the Polarity switch (S1), and associated wires for loose or faulty connections. Check the choke winding for continuity and test to be sure it is NOT grounded to the choke iron.
No AC welding output. DC welding output and auxiliary power are normal.	1. Make sure the Polarity switch (S1) is in the proper position and is "seated" correctly. 2. Make sure the electrode is correct for the process being used. 3. Make sure the welding cables are not coiled or too long.	1. Check the operation of the Polarity switch (S1). Also check the associated wires for loose or faulty connections. See Wiring Diagram. 2. Check for continuity from lead "S2" to lead "E" located in the main stator. See Wiring Diagram.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No constant voltage (CV) welding output. Constant current (CC) and the auxiliary power are operating normally.	1. Make sure the Range switch (S2) is in the proper position (CV) and "seated" correctly. 2. Make sure the wire feeder and welding cables are connected correctly.	1. Check the operation of the Range switch (S2) and check the associated wires for loose or faulty connections. See Wiring Diagram. 2. Check for continuity from leads C1, C2, and C3 to lead W1 located in the main stator. See Wiring Diagram.
The constant voltage (CV) welding output is low or unstable. Constant current (CC) and the auxiliary power are operating normally.	1. Make sure the Range switch (S2) is in the proper position (CV) and "seated" correctly. 2. Make sure the wire feeder and welding cables are connected correctly.	1. Check the operation of the Range switch (S2) and check the associated wires for loose or faulty connections. See Wiring Diagram. 2. The capacitor bank (C2, C3, C4, C5) may be faulty. Check or replace.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
Engine will not idle down to low speed. Machine has normal weld output and auxiliary power.	1. Make sure the Idler switch (S5) is in the "Auto" position. 2. Make sure there is NOT an external load on the weld terminals nor the auxiliary power receptacles.	1. With the Idler switch (S5) in the "AUTO" position and the engine running, check for the presence of 12VDC at leads #224D to #214, located at the Idler solenoid. If 12VDC is present and the idler solenoid is not activating, then the solenoid may be faulty or there is a mechanical restriction preventing it from functioning. 2. If there is NOT 12VDC at leads #224D to #214, then test for 12VDC from lead #224D to ground (lead #5). See Wiring Diagram. If 12VDC is present, then check lead #214 for continuity (zero ohms) from the idler solenoid to the printed circuit board plug 8J1. Also check the idler switch (S5) and the associated leads. See Wiring Diagram. If the above are OK, then the printed circuit board may be faulty. Replace. 3. If there is NOT 12VDC from lead #224D to ground (lead #5), then check the wiring to the engine terminal block connection. See Wiring Diagram.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
Engine will not go to high idle when attempting to weld. Welding output is normal when Idler switch is in "HIGH" position. Automatic idle function works properly when the auxiliary power is loaded.	1. Make sure the welding cables and connections are tight. 2. If attempting to "scratch" start, the WELDING TERMINALS switch (S6) must be in the "ALWAYS ON" position.	1. Check for broken or faulty connections in the sensing leads (#254 and #254A). Make sure their connections are tight at the work output terminal and also at the Polarity switch. See Wiring Diagram. 2. Make sure the leads are looped three times through the current sensor on the printed circuit board. 3. If using a wire feeder with a control cable, check the #2 and #4 circuit in the cable and in the machine. See Wiring Diagram.
Engine will not go to high idle when attempting to weld or when the auxiliary power is loaded. Welding output and auxiliary power output is normal when Idler switch is in the "HIGH" position.	1. Make sure the welding cables and connections are tight. 2. Automatic idler may not function if the auxiliary power is loaded to less than 150 watts.	1. Check for broken or faulty connections in the sensing leads (#254 and #254A). Make sure their connections are tight at the work output terminal and also at the Polarity switch. See Wiring Diagram. 2. Check lead #3 making sure it is looped through the current sensor on the printed circuit board. 3. The printed circuit board may be faulty. Replace.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
Engine will not crank or cranks very slowly.	1. Check for loose or faulty battery cable connections. 2. The battery may be faulty.	1. If the battery is replaced or tests good, then the charging circuit may be faulty. ***Perform the Charging Circuit Test.*** 2. The starter motor or starter solenoid may be faulty. 3. The engine may be hard to crank due to a mechanical failure in the engine.
The engine shuts off or will not start.	1. The engine may be low or out of fuel. 2. The oil level may be low. Check and fill to proper level. 3. The fuel filter may be clogged.	1. The oil pressure switch may be faulty. Replace if necessary. See Wiring Diagram.
The engine does not develop full power.	1. The fuel filter may be clogged. Replace if necessary. 2. The air filter may be clogged. Replace if necessary. 3. The spark plug may be faulty. Replace if necessary.	1. Due to wear, the engine may be in need of major repair.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
The welding arc is " cold." The engine runs normally (3700 RPM no load). The auxiliary power is functioning normally.	1. Check for loose or faulty connections at the weld output terminals and welding cable connections. 2. The welding cable may be too long or coiled, causing an excessive voltage drop.	1. Check for the correct open circuit voltage (OCV) at the welding output terminals, 80VAC Max. 75VDC Max. If the correct voltage is present at the output terminals, then check for loose connections on the heavy current carrying leads inside the RANGER 9. See Wiring Diagram. 2. If the OCV is low at the welder output terminals, then perform the ***Engine Throttle Adjustment Test.*** 3. Perform the ***Output Bridge Test.*** 4. Check for shorted or grounded windings in the reactor and also in the main stator. See Wiring Diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
Output control on welder not functioning.	1. Make sure the REMOTE switch (S4) is in the MACHINE CONTROL position. 2. The Output Control (R3) may be defective.	1. Check the Output Control (R3). Normal resistance is 10,000 ohms. Replace if defective. 2. Check the REMOTE switch (S4) and associated wiring. See Wiring Diagram (Leads 75, 76, and 77). 3. The Printed Circuit board may be faulty. Replace.
Remote output control not functioning.	1. Make sure the REMOTE switch (S4) is in the REMOTE position. 2. The remote control unit may be defective. Repair or replace.	1. Check the REMOTE switch (S4) and associated wiring. See Wiring Diagram (Leads #75, 76 and 77). 2. The bypass PC board may be faulty. Check or replace.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The wire feeder does not work when connected to the welder amphenol.	1. Check circuit breaker CB1. Reset is tripped. 2. The wire feeder control cable may be faulty. Check or replace. 3. The wire feeder may be faulty. Check or replace.	1. Check for the presence of 115VAC at leads #31A and 32. See Wiring Diagram. 2. Check for the presence of 42VAC at leads 31B to 42. See Wiring Diagram. 3. If any of the above voltages are missing or low, then check the circuit breaker CB1 for proper operation. 4. The bypass PC board may be defective. Check or replace. 5. Perform the ***Auxiliary and Field Winding Test.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The contactor does not pull in when scratch starting when the engine goes to high idle.	1. Make sure the WELDING TERMINALS switch (S6) is in the “ALWAYS ON” position.	1. Check the WELDING TERMINAL switch (S6) and associated wiring. 2. Check for the presence of 12VDC from lead #224 (+) to lead #232 (-) at the output contactor. If the correct voltage IS present and the contactor does not activate, then the contactor may be defective. Replace. 3. If the correct voltage is NOT present in step #2, check from lead #224 to ground (lead #5) for the presence of 12VDC. If the 12VDC is present, then check lead #232A to the Idler printed circuit board. 4. The printed circuit board may be faulty. Replace. 5. If 12VDC is NOT present from lead #224 to ground (lead #5), then check the #224 lead for an open circuit. See Wiring Diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The output contactor does not pull in when using a wire feeder with a control cable connected to the RANGER 9 amphenol.	1. Make sure the WELDING TERMINALS switch (S6) is in the "REMOTELY CONTROLLED" position. 2. Install a jumper wire from pins "D" to "C" on the 14 pin amphenol. If the output contactor activates, the problem is external to the RANGER 9. The wire feeder or the control cable may be faulty.	1. With the jumper installed in pins "D" and "C" in the 14 pin amphenol, check for 12VDC from leads #224 (+) to #232 (-) at the output contactor. If 12VDC is present and the contactor does not activate, then the contactor may be defective. 2. If the correct voltage is NOT present in step #2, check from lead #224 to ground (lead #5) for the presence of 12VDC. If 12VDC is present, then check the continuity of the lead #232A to the idler printed circuit board. 3. The printed circuit board may be faulty. Replace. 4. If 12VDC is NOT present from lead #224 to ground (lead #5), then check the #224 lead for an open circuit. See Wiring Diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The output contactor does NOT drop out.	1. Make sure the WELDING TERMINALS switch (S6) is in the "REMOTELY CONTROLLED" position. 2. Remove the wire feeder control cable from the amphenol. If the contactor "drops out," then the problem is external to the RANGER 9. Check the control cable or the wire feeder.	1. Remove lead #232 from the output contactor. If the contactor "drops out," then make sure that lead #232 is NOT grounded. Also check the WELDING TERMINALS switch (S6) for proper operation. Check associated wiring. See Wiring Diagram. The printed circuit board may be faulty. Replace. 2. If in step #1 the contactor does NOT drop out, then the contactor may be stuck. Repair or replace.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353.

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ROTOR VOLTAGE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the correct DC voltage is being applied to the rotor at maximum engine speed (3700 RPM). This information will aid the technician in determining if the generator field is operating properly.

MATERIALS NEEDED

Volt/Ohmmeter
5/16” Nut driver
Wiring Diagram

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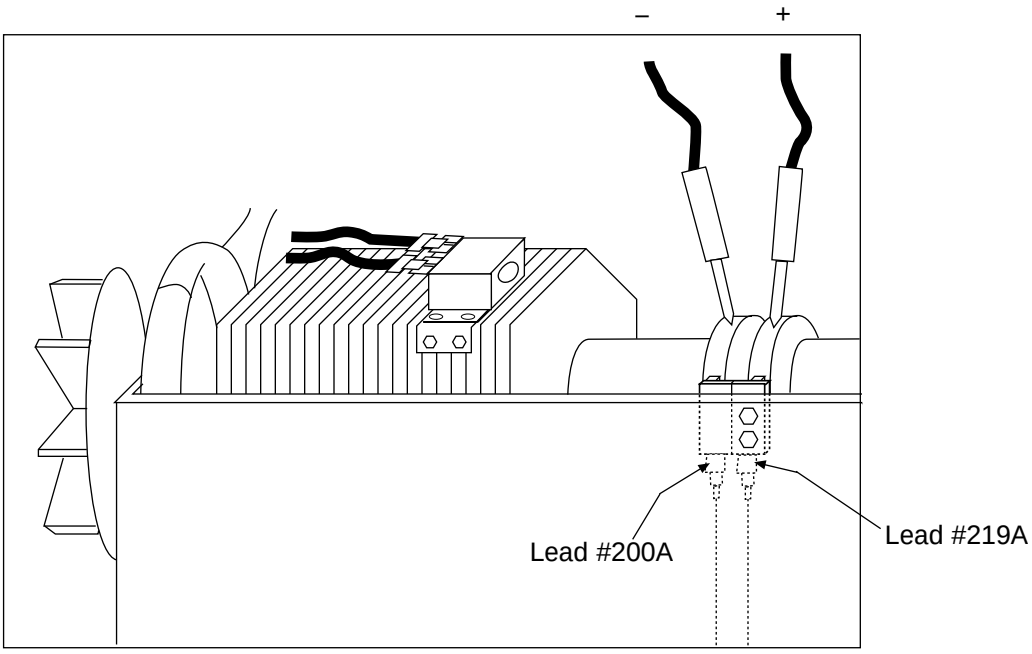
ROTOR VOLTAGE TEST *(continued)*

FIGURE F.1 - LOCATION OF LEAD 200A AND 219 FOR ROTOR VOLTAGE TEST



TEST PROCEDURE

1. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bale.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, **then reinstall the fuel cap.**
5. With the 5/16” nut driver, remove the 5 screws holding the right case side.
6. Remove the right case side by lifting up and out.
7. Set the volt/ohmmeter to the DC volts position.
8. Connect the positive meter probe to the brush nearest the rotor lamination (lead #200A). See Figure F.1 for location.
9. Connect the negative meter probe to the other brush (lead #219).
10. Start the engine and run it at high idle (3700 RPM). Set the output control to the MAXIMUM position (position 10).
11. Check the voltage reading on the voltmeter. It should read between 40 and 50 VDC.
12. If the voltage reading is low or not present, the generator field is not functioning properly. Perform the Rotor Resistance Test. The Field Diode Bridge (D2), the Field Capacitor (C1), and/or the Printed Circuit Board may be faulty.
13. If the voltage reading is normal, the field circuit is functioning properly. Install the right case side with the 5 sheet metal screws with the 5/16” nut driver. Remove the fuel cap; install the case top and tighten the 6 sheet metal screws with the 5/16” nut driver. Install the rubber gasket over the lift bale and install the fuel cap.

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ROTOR RESISTANCE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

TEST DESCRIPTION

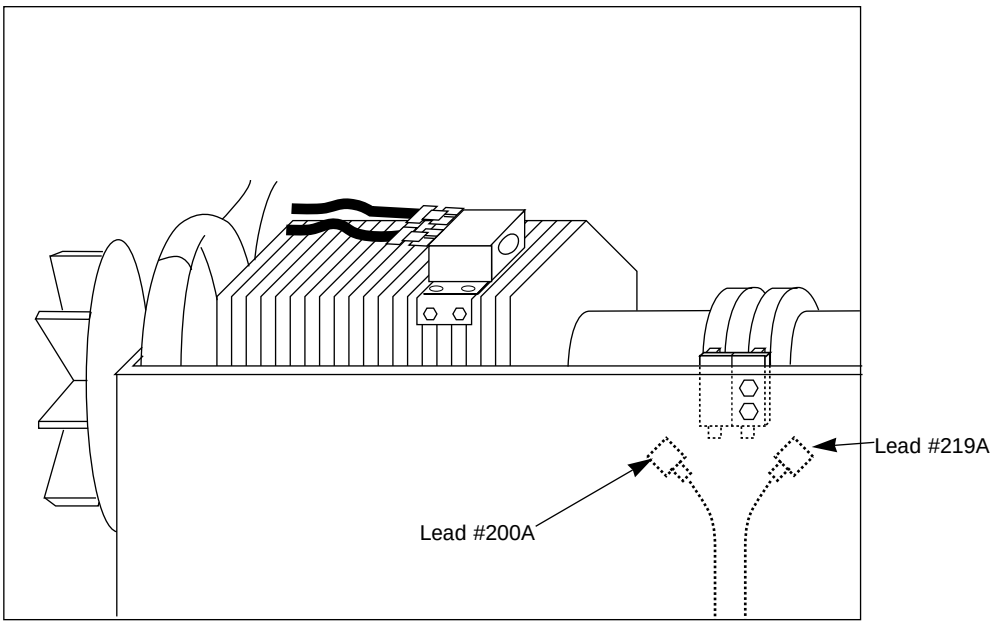
This test will determine if there is a shorted winding in the rotor or if the rotor is grounded.

MATERIALS NEEDED

Volt/Ohmmeter
5/16” Nut driver
Wiring Diagram

ROTOR RESISTANCE TEST *(continued)*

FIGURE F.2 – LOCATION OF ROTOR SLIP RINGS



TEST PROCEDURE

1. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bale.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, **then replace the fuel cap.**
5. With the 5/16” nut driver, remove the 5 screws holding the right case side.
6. Remove the right case side by lifting up and out.
7. Conduct the test with the gasoline engine OFF.
8. Remove the spark plug wires to prevent accidental engine kickback or starting.
9. Isolate the rotor electrically by removing the generator brush leads. Refer to Figure F.2 as you perform the remaining steps.
10. Remove lead #219 from the negative brush.
11. Remove lead #200A from the positive brush.
12. Measure the resistance across the rotor slip rings.
    A. Set the ohmmeter on the low scale (X1).
    B. Place one meter probe on one of the rotor slip rings. Place the other probe on the other slip ring.
    C. Check the resistance across the slip rings. It should read between 7 and 8 ohms.

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13. Measure the resistance to ground.

    A. Set the ohmmeter on the high scale (X100,000).

    B. Place one probe on either of the slip rings. Place the other probe on any good, unpainted ground. The machine ground stud works well.

    C. Check the resistance. It should read very high, at least 0.5 megohm (500,000 ohms).

    If the test does not meet the resistance specifications, then the rotor may be faulty. Replace the rotor.

    If the test does meet the resistance specifications, then the rotor is okay.

14. Connect lead #200A to the positive brush, which is the one nearest the rotor lamination. Connect lead #219 to the negative brush.

15. Reinstall the case side, case top, fuel cap, lift bale gasket and spark plug wires.

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AUXILIARY AND FIELD WINDING TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the correct AC voltages are being generated from the stator windings.

MATERIALS NEEDED

Volt/Ohmmeter
5/16” Nut driver
Wiring Diagram

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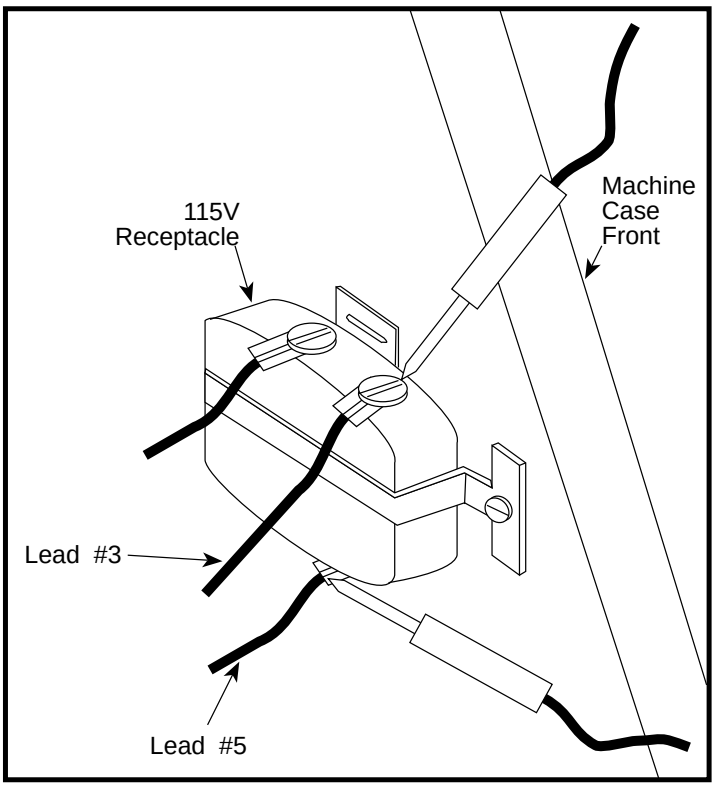
AUXILIARY AND FIELD WINDING TEST *(continued)*

FIGURE F.3 – LOCATION OF LEADS #3 AND #5



TEST PROCEDURE

To test the 115 VAC winding:

1. Remove the fuel cap and lift bale rubber gasket. With the 5/16" nut driver, remove the case top and left side; then reinstall the fuel cap.
2. Connect the volt/ohmmeter probes to leads #3 and #5 where they connect to the 115 VAC receptacle. See Figure F.3.
3. Start the engine and run it at high idle (3700 RPM).
4. Set the output control to the maximum position (position 10).
5. Check the AC voltage reading. It should be approximately 125 VAC.

To test the 230 VAC winding:

1. Remove the fuel cap and lift bale rubber gasket. With the 5/16" nut driver, remove the case top and left side; **then reinstall the fuel cap.**
2. Connect the volt/ohmmeter probes to leads #6 and #3 where they connect to the 230 VAC receptacle.

NOTE: It is easier to insert the probes directly into the receptacle to perform this test. However, the probes may not reach in far enough to make or keep a good connection. In this case, before you start the gasoline engine, insert two test probes into the receptacle. Hold the test probes firmly in place to measure voltage (Step 5).

3. Start the engine and run it at high idle (3700 RPM)
4. Set the output control to the maximum position (position 10).
5. Check the AC voltage reading. It should be approximately 240 VAC.

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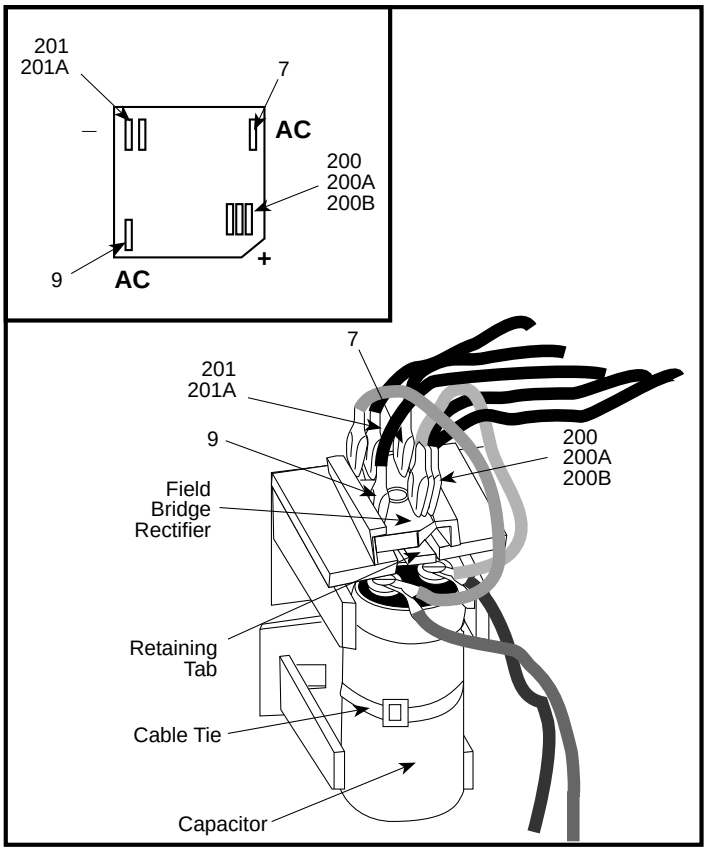
AUXILIARY AND FIELD WINDING TEST *(continued)*

FIGURE F.4 - LOCATION OF LEADS #7 AND #9 AT FIELD BRIDGE RECTIFIER



To test the field winding:

1. Remove the fuel cap and lift bale rubber gasket. With the 5/16" nut driver, remove the case top and left side; **then reinstall the fuel cap.**
2. Connect the volt/ohmmeter probes to leads #7 and #9 where they connect to the Field Bridge Rectifier. See Figure F.4.
3. Start the engine and run it at high idle (3700 RPM).
4. Set the output control to the maximum position (position 10).
5. Check the AC voltage reading. It should be between 40 and 50 VAC.

If any one or more of the readings are missing or not within specifications, then check for loose or broken wires between the test points and the stator windings. See the Wiring Diagram. Make sure the windings are NOT grounded internally to the stator iron. If the leads are intact, then the stator may be faulty. Replace the stator.

If the voltage readings are within specifications, then the windings are good and functioning properly.

6. Reinstall the case side, case top, fuel cap, and lift bale gasket.

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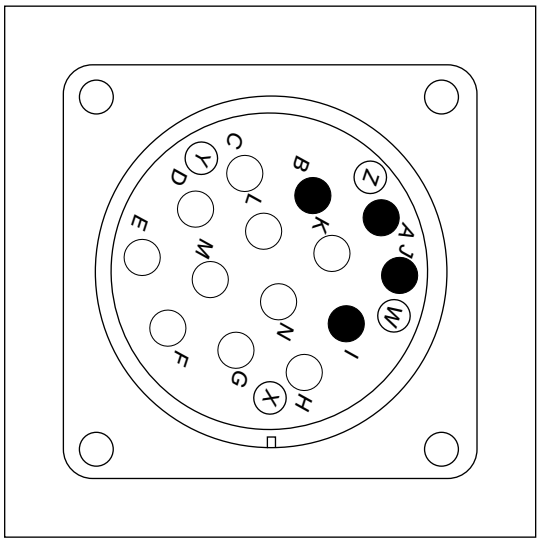
AUXILIARY AND FIELD WINDING TEST *(continued)*

FIGURE F.4A - 14 PIN AMPHENOL PIN ASSIGNMENTS



To test the feeder winding:

1. Remove the fuel cap and lift bail rubber gasket. With the 5/16" nut driver, remove the case top and left side; then reinstall the fuel cap.
2. Connect the volt/ohmmeter probes to leads #31 and #32 where they connect to the circuit breaker CB1 and the 14 pin amphenol. See the Wiring Diagram.

NOTE: It is possible to check this voltage reading at the amphenol by inserting the test probes at pin A (for lead #32) and J (for lead #31A). See Figure 4A. However, if you use this method and get no voltage reading, it could mean there is a break or loose connection in the leads between the circuit breaker and the amphenol. Check the reading again with one probe at the circuit breaker connection for lead #31 and the other probe at amphenol pin A.

3. Start the engine and run it at high idle (3700 RPM).
4. Set the output control to the maximum (position 10).
5. Check the AC voltage reading. It should be between 115 and 126 VAC.
6. Connect the volt/ohmmeter probes to leads #31 and #42 where they connect to the cirbuit breaker CB1 and the 14 pin amphenol. See the Wiring Diagram.

NOTE: It is possible to check this voltage reading at the amphenol by inserting the test probes at pin K (for lead #42) and I (for lead #31B). See Figure 4A. However, if you use this method and get no voltage reading, it could mean there is a break or loose connection in the leads between the circuit breaker and the amphenol. Check the reading again with one probe at the circuit breaker connection for lead #31 and the other probe at amphenol pin K.

7. Set the output control to the maximum position (position 10).
8. Check the AC voltage reading. It should be between 43 and 50 VAC.

AUXILIARY AND FIELD WINDING TEST *(continued)*

If the voltage readings are within specifications, then the windings are good and functioning correctly.

If any one or more of the readings are missing or not within specifications, then check for loose or broken wires between the test points and the stator windings. See the Wiring Diagram. Make sure that the windings are NOT grounded internally to the stator iron. If the leads are intact, then the stator may be faulty. Replace the stator.

9. Reinstall the left case side, case top, fuel cap, and lift bail gasket.

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OUTPUT RECTIFIER BRIDGE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are faulty diodes in the Output Rectifier Bridge.

MATERIALS NEEDED

Volt/Ohmmeter (Diode Tester)
5/16” Nut driver
1/2” Socket wrench
Wiring Diagram

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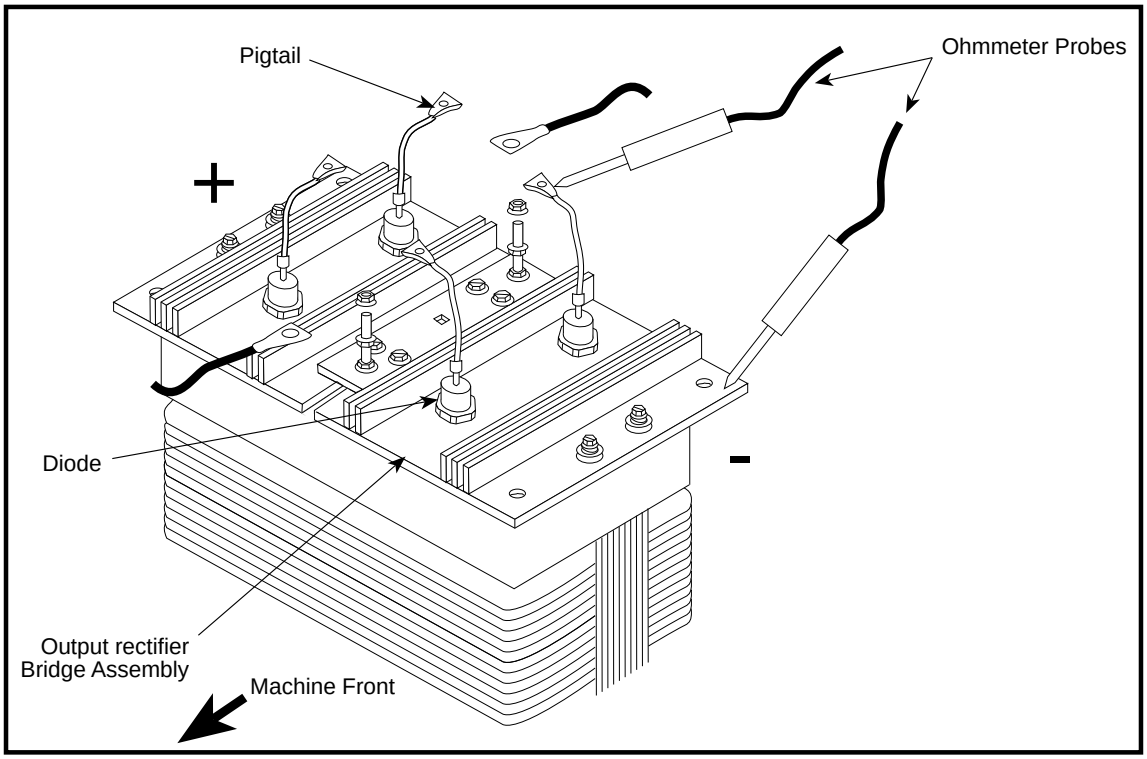
OUTPUT RECTIFIER BRIDGE TEST *(continued)*

FIGURE F.5 – LOCATION OF OUTPUT RECTIFIER LEADS



TEST PROCEDURE

1. Remove the spark plug wires to prevent accidental engine kickback or starting.
2. WIth the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bale.
4. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, **then replace the fuel cap.**
6. With the 5/16” nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. Conduct the test with the gasoline engine OFF.
9. Locate the Output Rectifier Bridge behind the machine case front.
10. With the 1/2” socket wrench, remove the nuts and washers holding the diode bridge pigtails and the heavy current-carrying leads to the studs located in the middle of the rectifier assembly. Note their locations and the order of fasteners for reassembly.
11. Electrically isolate the diode pigtails by bending them back into “free air.”
12. With an ohmmeter or diode tester, check each of the four diodes from their pigtails to their respective heat sinks. See Figure F.5.
13. Reverse the tester leads and check the diodes again. Diodes should have a low resistance in one polarity and a very high resistance in the opposite polarity.
14. Replace any “shorted” or “open” diode as the tests indicate.
15. Reconnect the diode pigtails and heavy leads to their respective studs.
16. Reinstall the case side, case top, fuel cap, lift bale gasket and spark plug wires.

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CHARGING CIRCUIT TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

TEST DESCRIPTION

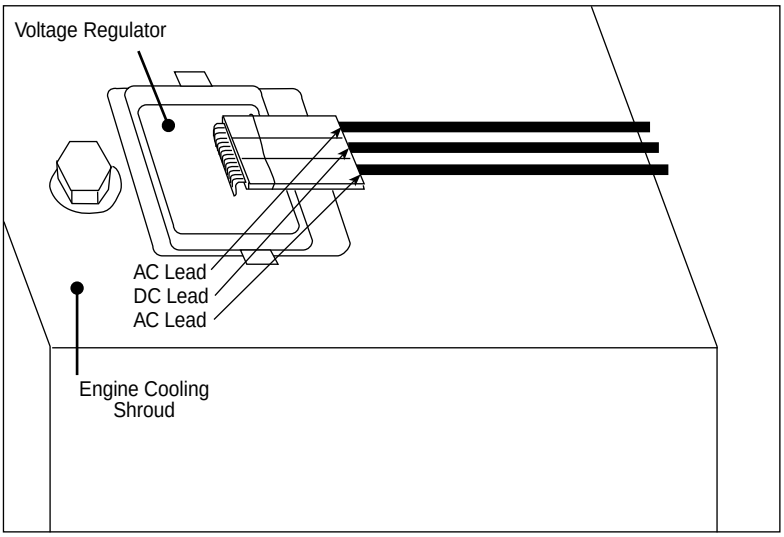
This test will determine if the Flywheel Alternator, Regulator, and associated circuitry are functioning properly.

MATERIALS NEEDED

Volt/Ohmmeter
5/16” Nut driver
Wiring Diagram

CHARGING CIRCUIT TEST *(continued)*

FIGURE F.6 – LOCATION OF VOLTAGE REGULATOR



TEST PROCEDURE

1. Start the engine and run it at high idle (3700 RPM).
2. Set the voltmeter for AC volts and place one meter probe on each of the two outside leads that attach to the engine voltage regulator. See FIgure F.6 for location. Check for 52 VAC at the voltage regulator.
3. If the AC voltage is low or not present, the engine flywheel alternator may be faulty. This is an engine problem; consult your local engine repair facility.
4. If the voltage reading is correct, then check the output of the voltage regulator to determine the charging voltage for the battery. Run the engine at high idle (3700 RPM). Set the voltmeter for DC volts and place one meter probe on any good ground. See Figure F.6. Check for 13-15 VDC.
5. If the DC voltage reading is incorrect or not present, the voltage regulator may be faulty. Replace the entire voltage regulator module.
6. If the DC voltage reading is correct, check the associated wiring and circuitry. See the Wiring Diagram.

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ENGINE THROTTLE ADJUSTMENT TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

TEST DESCRIPTION

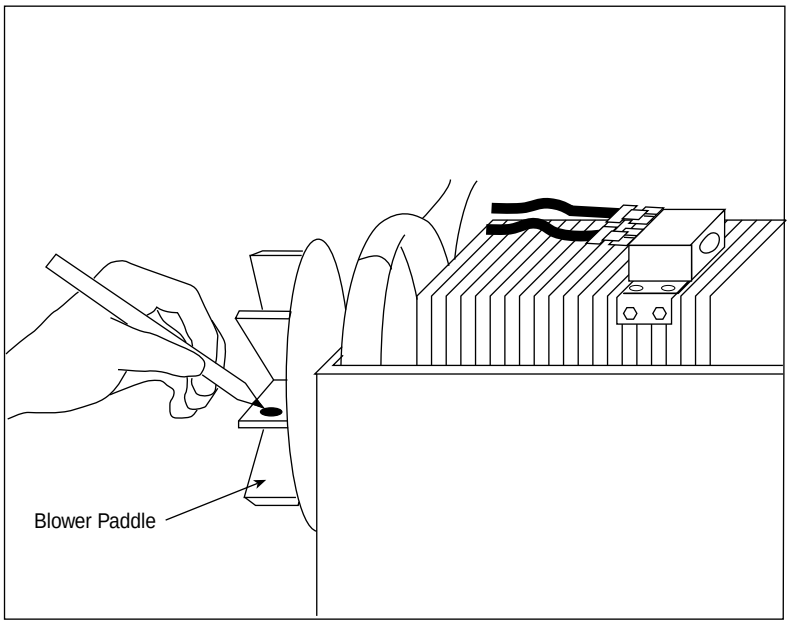
If the machine output is low, this test will determine whether the gasoline engine is operating at the correct speed (RPM) during both HIGH and LOW idle conditions. Directions for adjusting the throttle to the correct RPM are given.

MATERIALS NEEDED

5/16” Nut driver
3/8” open end or box wrench
Strobe-tach, frequency counter, oscilloscope, or vibratach
Black or red marking pencil

ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

FIGURE F.7 – BLOWER PADDLE MARKED FOR STROBE-TACH METHOD



TEST PROCEDURE

This test can be conducted by any one of four methods.

Strobe-tach Method:

1. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bale.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, **then replace the fuel cap.**
5. Conduct this procedure with the gasoline engine OFF.
6. Remove the spark plug wires to prevent accidental engine kickback or starting.
7. With the black or red marking pencil, place a mark on one of the blower paddles. See Figure F.7 for location.
8. Connect the strobe-tach according the manufacturer’s instructions.
9. Reconnect the spark plug wires and start the engine. Direct the strobe-tach light on the blower paddle and synchronize it to the rotating mark.
10. With the machine at HIGH IDLE the tach should read between 3700 and 3750 RPM.

    With the machine at LOW IDLE the tach should read between 2150 and 2250 RPM.

ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

FIGURE F.8
HIGH IDLE ADJUSTMENT NUT

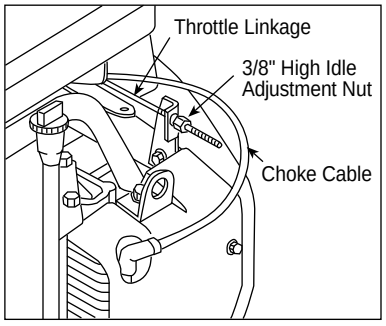
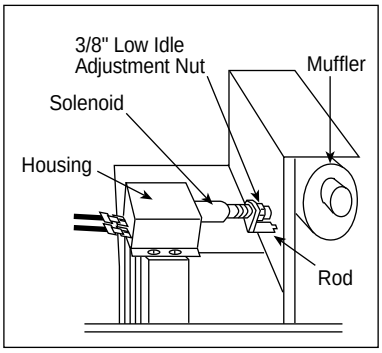


FIGURE F.9
LOW IDLE ADJUSTMENT NUT



11. If either of the readings is incorrect, adjust the throttle as follows:

    Adjust HIGH IDLE: Use the 3/8” wrench to turn the spring-loaded adjustment nut. See Figure F.8 for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the tach reads between 3700 and 3750 RPM.

    Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLE switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8” wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.9 for location of the adjustment nut. Adjust the nut until the tach reads between 2150 and 2250 RPM.

Frequency Counter Method

1. Plug the frequency counter into one of the 115 VAC auxiliary receptacles.
2. Start the engine and check the frequency counter. At HIGH IDLE (3700 RPM), the counter should read 63 Hz. At LOW IDLE (2200 RPM), the counter should read 37 Hz. Note that these are median measurements; hertz readings may vary slightly above or below.
3. If either of the readings is incorrect, adjust the throttle as follows:

   Adjust HIGH IDLE: Use the 3/8” wrench to turn the spring-loaded adjustment nut. See Figure F.8 for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the frequency reads 63 Hz.

   Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8” wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.9 for location of the adjustment nut. Adjust the nut until the frequency reads 37 Hz.

ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

Oscilloscope Method:

1. Connect the oscilloscope to the 115 VAC receptacle, according to the manufacturer's instructions. At 3700 RPM, the waveform should exhibit a period of 15.8 milliseconds. At 2200 RPM, the waveform should exhibit a period of 27.02 milliseconds. Refer to NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115 VAC SUPPLY) HIGH IDLE – NO LOAD in this section of the manual.
2. If either waveform periods is incorrect, adjust the throttle as follows:

   Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See Figure F.8 for location of the adjustment nut. Adjust the speed until the period is 15.8 mililseconds.

   Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.9 for location of the adjustment nut. Adjust the speed until the period is 27.02 milliseconds.

Vibratach Method:

1. Place the vibratach as close to the engine as possible. With the machine case top removed, the top of the air cleaner is the best location.
2. Start the engine and observe the whip handle of the vibratach. At HIGH IDLE (3700 RPM), the whip handle should exhibit maximum oscillation. At LOW IDLE (2200 RPM), the whip handle should exhibit minimum oscillation. Note that these are median measurements; vibratach readings may vary slightly above or below.
3. If either of the vibratach indications is incorrect, adjust the throttle as follows:

   Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See Figure F.8 for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the vibratach whip handle exhibits maximum oscillation at 3700 RPM.

   Adjust LOW IDLE: First make sure that there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.9 for location of the adjustment nut. Adjust the speed until the vibratach whip handle exhibits minimum oscillation at 2150 to 2250 RPM.

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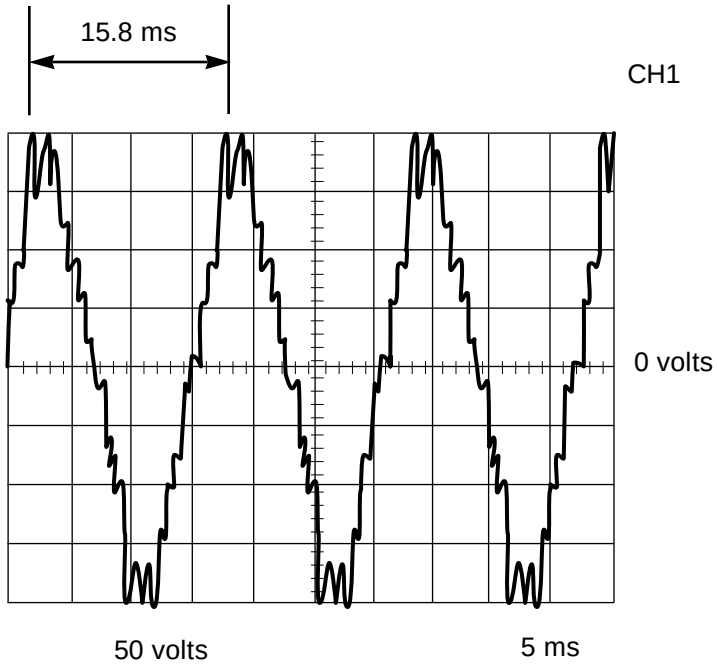
NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115VAC SUPPLY)

HIGH IDLE – NO LOAD – OUTPUT CONTROL AT MAXIMUM



This is the typical auxiliary output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

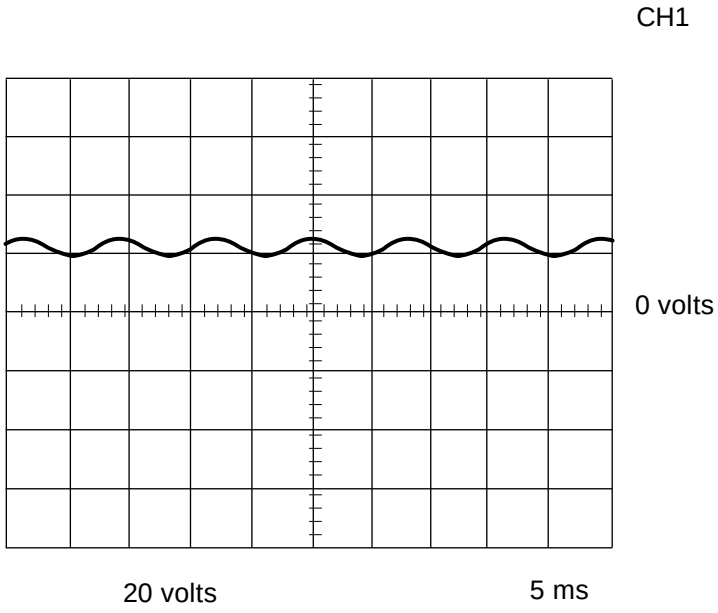
Note: Scope probes connected at machine 115VAC receptacle.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

TYPICAL DC WELD OUTPUT VOLTAGE WAVEFORM (CV MODE HIGH TAP)

MACHINE LOADED



MACHINE LOADED TO 250 AMPS AT 25VDC

This is the typical CV output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time. The machine was loaded with a resistance grid bank.

Note: Scope probes connected at machine output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

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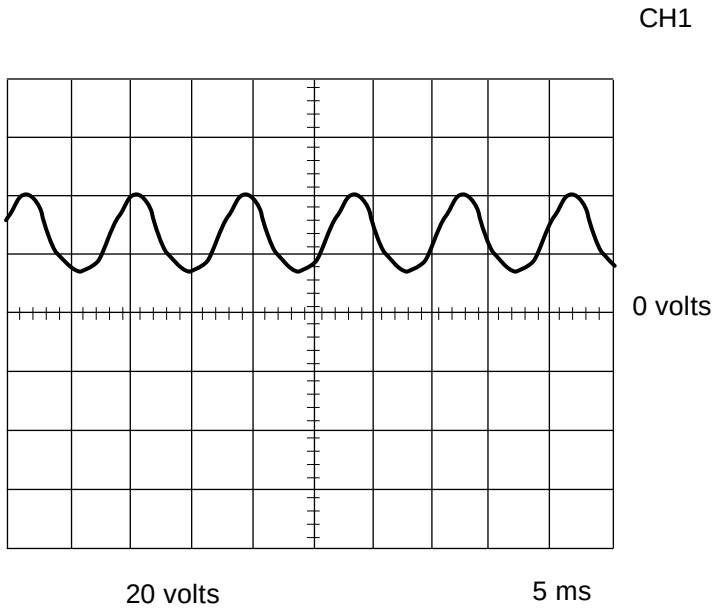
TYPICAL DC WELD OUTPUT VOLTAGE WAVEFORM

MACHINE LOADED



MACHINE LOADED TO 250 AMPS AT 25 VDC

This is the typical DC output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time. The machine was loaded with a resistance grid bank.

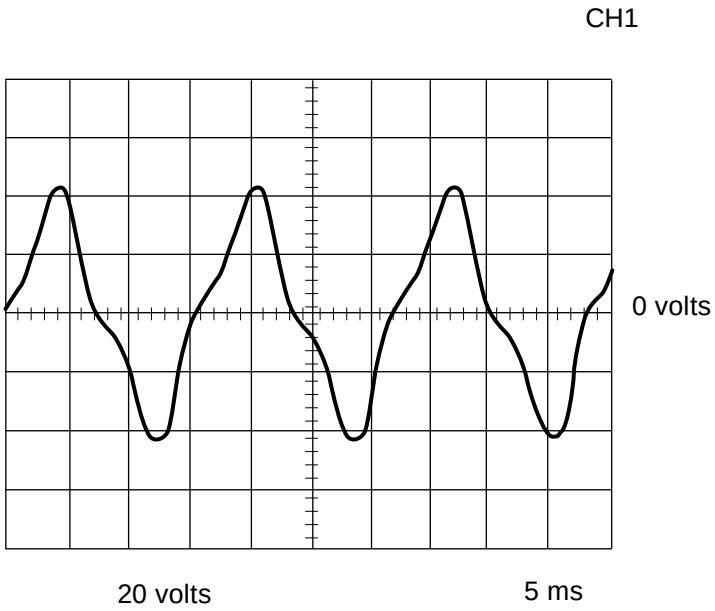
Note: Scope probes connected at machine output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

TYPICAL AC WELD OUTPUT VOLTAGE WAVEFORM

MACHINE LOADED



MACHINE LOADED TO 250 AMPS AT 25VDC

This is the typical AC output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time. The machine was loaded with a resistance grid bank.

Note: Scope probes connected at machine output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

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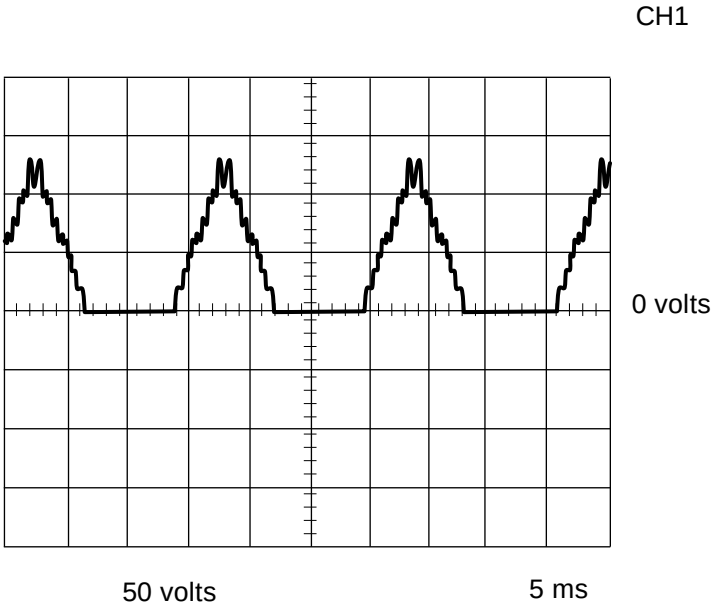
Return to Master TOC

ABNORMAL OPEN CIRCUIT DC WELD VOLTAGE WAVEFORM

HIGH IDLE - NO LOAD - OUTPUT CONTROL AT MAXIMUM
ONE OUTPUT DIODE NOT FUNCTIONING



This is NOT the typical DC (+) output voltage waveform. One output diode is not functioning. Note the “gap” in the waveform. One output diode was disconnected to simulate an open or non-functioning output diode. Each vertical division represents 50 volts and each horizontal division represents 5 milliseconds in time.

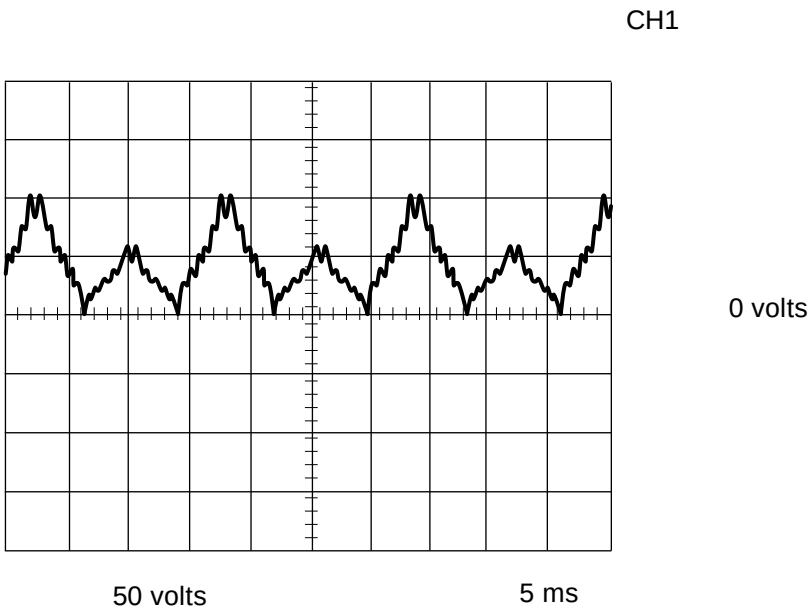
Note: Scope probes connected at machine output terminals.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

ABNORMAL OPEN CIRCUIT WELD VOLTAGE WAVEFORM (HIGH CV MODE)

HIGH IDLE – NO LOAD – OUTPUT CONTROL AT MAXIMUM OUTPUT CAPACITOR BANK NOT FUNCTIONING



This is NOT the typical CV output voltage waveform. The capacitor bank is not functioning. Note the "ripple" in the waveform. The capacitor bank was disconnected to simulate an open or non-functioning capacitor bank. Each vertical division represents 50 volts and each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine output terminals.

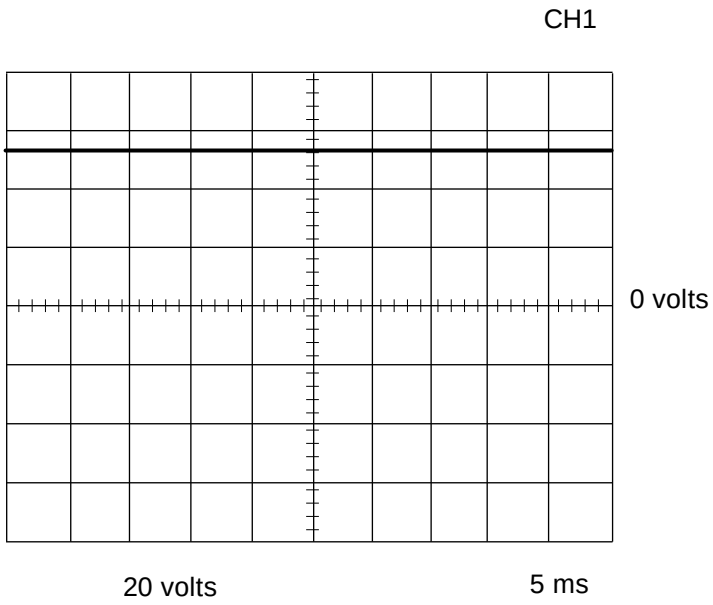
SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

NORMAL OPEN CIRCUIT WELD VOLTAGE WAVEFORM (HIGH CV MODE)

HIGH IDLE – NO LOAD – OUTPUT CONTROL AT MAXIMUM



This is the typical CV output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine output terminals.

SCOPE SETTINGS

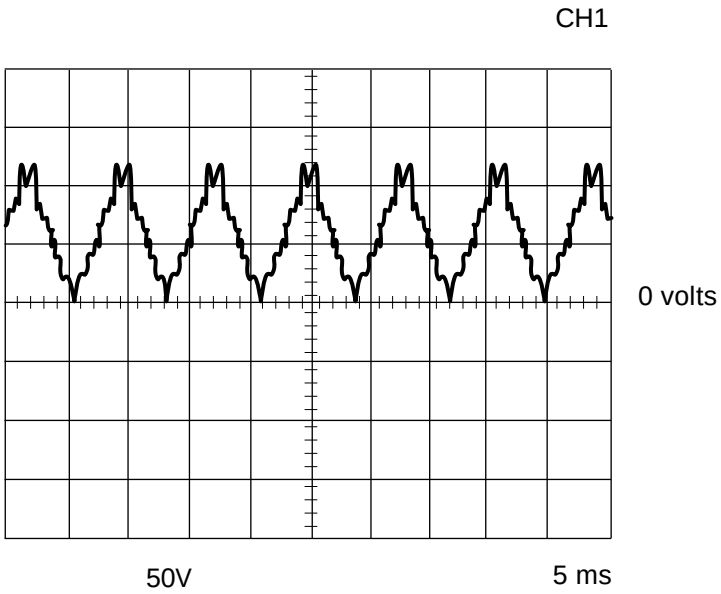
Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

NORMAL OPEN CIRCUIT DC WELD VOLTAGE WAVEFORM

HIGH IDLE – NO LOAD – OUTPUT CONTROL AT MAXIMUM



This is the typical DC output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine output terminals.

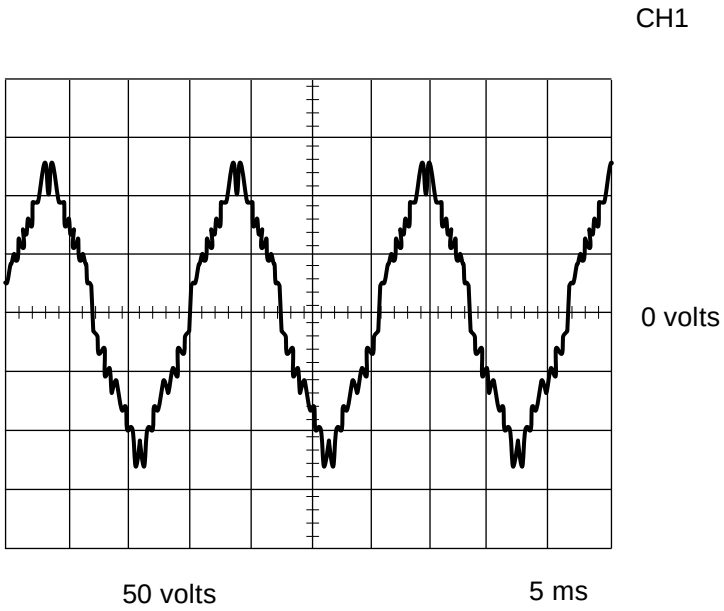
SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

NORMAL OPEN CIRCUIT AC WELD VOLTAGE WAVEFORM

HIGH IDLE – NO LOAD – OUTPUT CONTROL AT MAXIMUM



This is the typical AC output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine output terminals.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

BRUSH REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in accessing the generator brushes for maintenance or replacement.

MATERIALS NEEDED

5/16” Nut driver
5/16” Open end wrench
3/8” Wrench
7/16” Wrench
Slot head screw driver
Needle nose pliers

Return to Section TOC
Return to Master TOC

BRUSH REMOVAL AND REPLACEMENT *(continued)*

PROCEDURE

1. Remove the spark plug wires.
2. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bale.
4. Remove the fuel cap. The rubber gasket for the fill tube with come off with the case top.
5. Remove the case top, **then reinstall the fuel cap.**
6. WIth the 5/16” nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. With the 3/8” wrench, remove the screws holding the right stator cover. This will expose the brush holder assembly.
9. With the needle nose pliers, gently remove the blue and the red wires from the brushes. See Figure F.10.
10. With the 7/16” wrench, remove the brush holder assembly bracket from the stator frame.
11. With the 5/16” open end wrench, remove the two screws that secure the brush holder assembly to the bracket. Slide the brush holder assembly out of the bracket.
12. To change the brushes, use the slot head screw driver to pop off the plastic retainer on the back of the brush holder assembly.
13. Remove the old brushes and insert the new ones. One corner of the terminal clip is beveled so that the brush can go in only one way.
14. Snap the plastic retainer back onto the brush holder. The brushes may need some repositioning; wiggle them slightly to help them seat properly on the slip rings.
15. To reinstall the brushes, depress the spring-loaded brushes into the holder and slip a suitable non-metallic, fairly stiff retainer through the slots at the top and bottom of the holder. A cable tie works well; see Figure F.10. This will hold the brushes up so that you can easily install the holder.
16. Slide the brush holder assembly back into the bracket and, with the 5/16” open end wrench, install the two screws that hold it in place.
17. With the 7/16” wrench, install the brush holder assembly bracket to the stator frame.
18. Slowly remove the non-metallic retainer from the brush holder and let the brushes snap back against the slip rings.
19. With the needle nose pliers, connect the red and the black wires to the appropriate terminals on the brushes. The red wire is inboard.
20. Check the wire connections for clearance and tightness.
21. Reinstall the right stator cover, case side, fuel cap, lift bale gasket, case top, and spark plug wires.

BRUSH REMOVAL AND REPLACEMENT *(continued)*

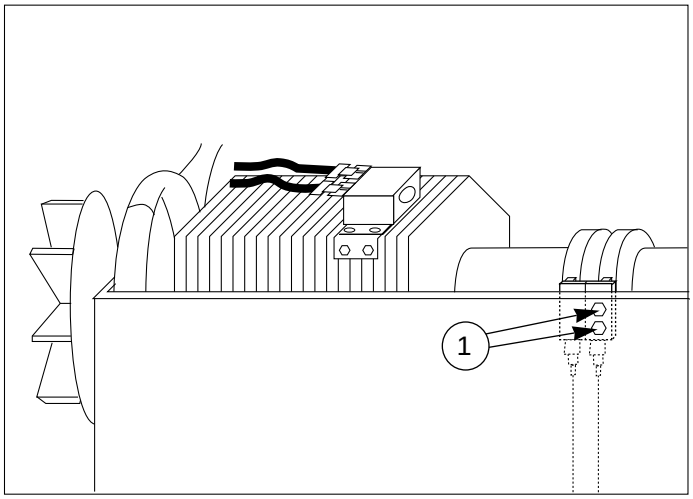
SLIP RINGS

A slight amount of darkening and wear of the slip rings and brushes is normal. Brushes should be inspected when a general overhaul is necessary. If brushes are to be replaced, clean slip rings with a fine emery paper.

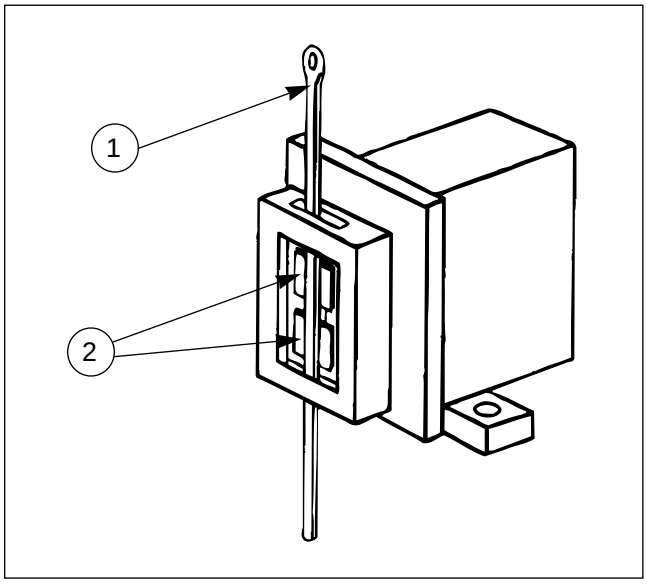
⚠ CAUTION

Do not attempt to polish slip rings while engine is running.

FIGURE F.10 - BRUSH LEADS/BRUSHES RETAINED WITH CABLE TIE



1. BRUSH HOLDER ASSEMBLY BRACKET BOLTS



1. CABLE TIE
2. BRUSHES

Return to Section TOC
Return to Master TOC

FIELD CAPACITOR AND/OR RECTIFIER BRIDGE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in accessing and removing the field capacitor and rectifier bridge for maintenance or replacement of either component.

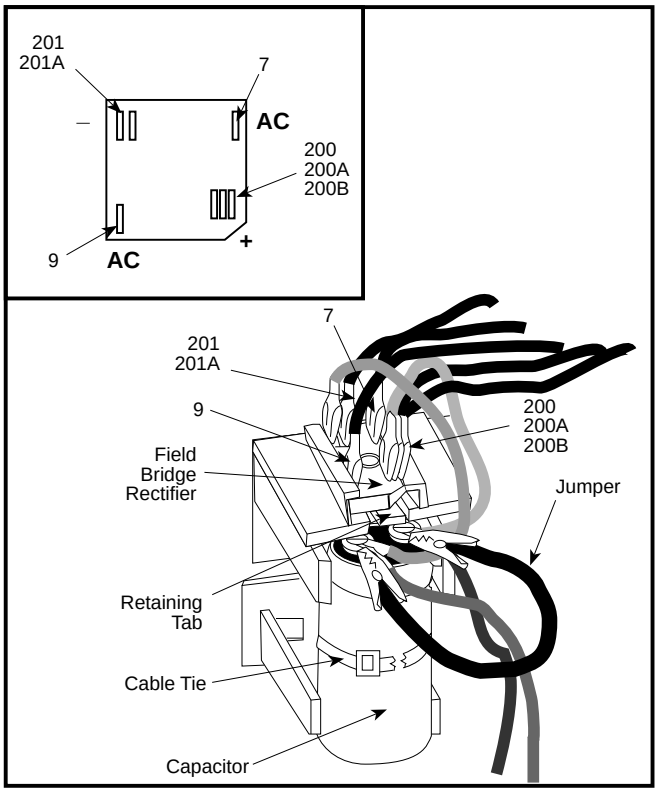
MATERIALS NEEDED

5/16” Nut driver
Jumper wire with alligator clips on each end for discharging the field capacitor
Slot head screw driver
Needle nose pliers
Wiring Diagram

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FIELD CAPACITOR AND/OR RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.11
RECTIFIER BRIDGE LOCATION AND DISCHARGING THE FIELD CAPACITOR



PROCEDURE

1. Remove the engine spark plug wires.
2. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bale.
4 Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, **then reinstall the fuel cap.**
6. With the 5/16” nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. Discharge the field capacitor by connecting the jumper wire clips on the black and the red wire terminals on the top of the capacitor. See Figure F.11 for location. Leave the clips on for at least 5 seconds, then remove.
9. Both the capacitor and the rectifier bridge are mounted in a molded plastic holder. To remove it, pull out on the top of the holder, then slide it upward.
10. Cut the cable tie and then snap the capacitor out of the assembly.
11. Loosen the two screws on the top of the capacitor. Lead 200 attaches to the positive (+) terminal. Lead 201 attaches to the negative terminal (-) terminal.
12. To install the capacitor, reattach the leads to their respective terminals [200 to positive (+); 201 to negative (-)] and tighten the screws. Snap the capacitor back into the molded plastic holder and slide the holder back into position in the panel. Replace the cable tie.
13. Reinstall the case side, fuel cap, lift bale gasket, case top, and spark plug wires.

FIELD CAPACITOR AND/OR RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

PROCEDURE - RECTIFIER BRIDGE REMOVAL AND REPLACEMENT

1. To remove the rectifier bridge, first you will have to remove the field capacitor. Follow Steps 1 - 10 above.
2. Depress the retainer clip on the molded plastic holder and slide the rectifier bridge out.
3. With the needle nose pliers, gently remove the 6 wires from the rectifier bridge.
4. Replace the wires to their appropriate locations on the new rectifier bridge (See the Wiring Diagram.):

   Lead #200 and #200A are piggybacked on the positive (+) terminal. Depending on the bridge used, this corner may be beveled and/or marked with a + sign.

   Lead #201 and #201A are piggybacked on the negative (-) terminal, which will always be located diagonally across from the positive (+) terminal.

   The two leads #7 and #9 are the AC side of the bridge and attach to the other two corners. Either lead can go on either terminal.
5. Slide the bridge back into the molded plastic holder until the retainer clip snaps it securely in place. Snap the capacitor back into the holder and then slide the unit back into position in the panel. Replace the cable tie.
6. Check that the leads are not grounded and for clearance and tightness.
7. Reinstall the case side, fuel cap, lift bale gasket, and case top.

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the printed circuit board for maintenance or replacement.

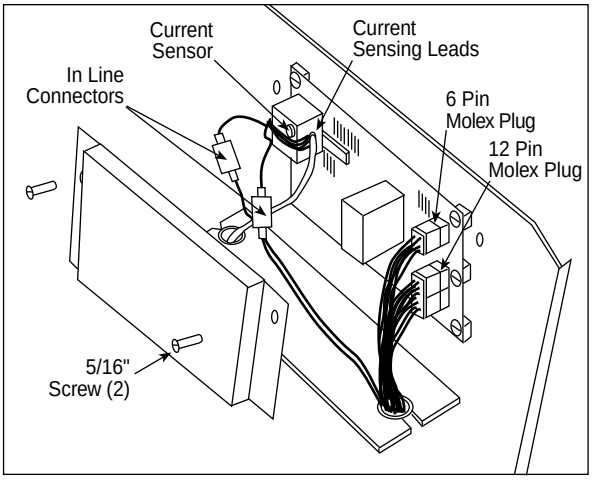
MATERIALS NEEDED

5/16” Nut driver
1/4” Nut driver
Diagonal cutters
Wiring Diagram

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT
(continued)

FIGURE F.12 - PRINTED CIRCUIT BOARD LOCATION



PROCEDURE

Before starting the following procedure, refer to the topic "PC Board Troubleshooting Procedures" at the beginning of this section.

1. Remove the engine spark plug wires.
2. With the 5/16" nut driver, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bale.
4. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, **then reinstall the fuel cap.**
6. With the 5/16" nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. WIth the 5/16" nut driver, remove the printed circuit board cover. See Figure F.12.
9. Remove the two molex plugs from the printed circuit board.
10. Detach the two in-line connectors from the current sensing leads (#254 and #254A - see the Wiring Diagram). These leads attach to the current sensor located on the printed circuit board.
11. Remove lead #3 from the 115 VAC receptacle. Thread the lead through the hole in the current sensor in order to separate it from the printed circuit board. It will probably be necessary to cut any cable ties restraining the wiring. Use the diagonal cutters.

Return to Section TOC
Return to Master TOC

PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT *(continued)*

⚠ CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

12. With the 1/4” nut driver, remove five screws holding the printed circuit board.
13. Replace the old printed circuit board with a new one.
14. Thread lead #3 back through the current sensor on the printed circuit board and reattach the lead to the 115 VAC receptacle.
15. Connect current sensing leads #254 and #254A. See the Wiring Diagram for the proper connections.
16. Connect the two molex plugs.
17. Replace any cable ties that were cut during the removal procedure.
18. With the 5/16” nut driver, install the printed circuit board cover.
19. Reinstall the case side, fuel cap, lift bale gasket, case top, and spark plug wires.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the output rectifier bridge for maintenance or replacement.

MATERIALS NEEDED

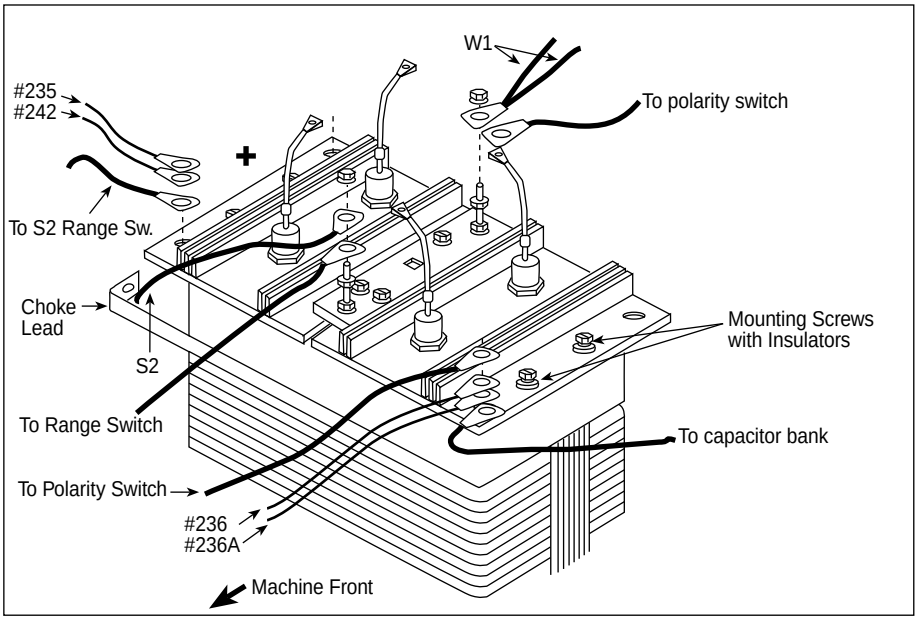
5/16” Nut driver
1/2” Wrench
3/8” Wrench
Slot head screw driver
Dow Corning 340
Wiring Diagram

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.13 - OUTPUT RECTIFIER CONNECTIONS



PROCEDURE

1. Remove the engine spark plug wires.
2. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bale.
4. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, **then reinstall the fuel cap.**
6. With the 5/16” nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.

For the remaining steps, refer to Figure F.13.

8. With the 1/2” wrench, remove the choke lead, heavy lead from the S2 range switch, leads #235 and #242 from the rectifier positive heat sink.
9. With the 1/2” wrench, remove the two heavy leads and leads #236 and #236A from the rectifier negative heat sink.
10. With the 1/2” wrench, remove the W1 lead and the heavy lead going to the S1 Polarity switch. Note lead and washer placement.
11. With the 1/2” wrench, remove the S2 lead and the heavy lead going to the S2 Range switch. Note lead and washer placement.

OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT *(continued)*

12. With the 3/8” wrench and slot head screw driver, remove the four mounting screws (two on each side). Note the placement of the nylon insulators. **These must be in place when you reinstall the rectifier bridge assembly in order to electrically insulate the bridge from the choke lamination assembly.**
13. Remove the rectifier assembly by tilting it up and lifting it toward the front of the machine.
14. Reassembly: Refer to the Wiring Diagram for proper connections to the positive and negative sides of the rectifier assembly. The two sides of the bridge are marked + and -, respectively.

NOTE: Use Dow Corning 340 on all aluminum electrical connection surfaces.

15. WIth the 3/8” wrench and slot head screw driver, install the four mounting screws (two on each side). Note the placement of the nylon insulators. **These must be in place when you install the rectifier bridge assembly in order to electrically insulate the bridge from the choke lamination assembly.**
16. With the 1/2” wrench, install the S2 lead and the heavy lead going to the Range switch. Note the order of fasteners and leads.
17. With the 1/2” wrench, install the W1 lead and the heavy lead going to the Polarity switch. Note the order of fasteners and leads.
18. With the 1/2” wrench, install the two heavy leads and leads #236 and #236A to the rectifier negative heat sink. Note the order of fasteners: bolt and flat washer from the bottom up through the heat sink; on top, leads, flat washer, lock washer, and nut.
19. With the 1/2” wrench, install the choke lead, the heavy lead, and leads #235 and #242 to the rectifier positive heat sink. Note the order of fasteners: bolt and flat washer from the bottom up through the heat sink; on top, leads, flat washer, lock washer, and nut.
20. Reinstall the case side, fuel cap, lift bale gasket, case top, and spark plug wire.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

OUTPUT CAPACITOR REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

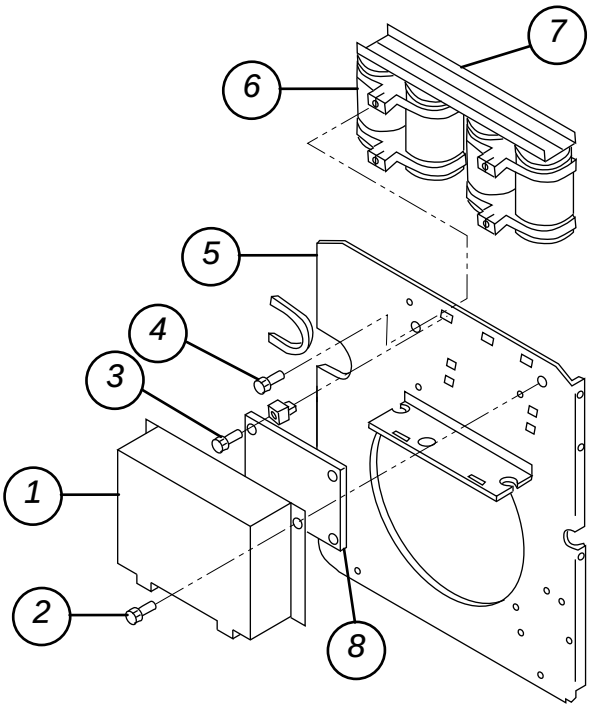
The following procedure will aid the technician in removing the output capacitor bank of four capacitors for maintenance or replacement.

MATERIALS NEEDED

Volt/Ohmmeter
25-watt resistor
5/16” Nut driver
1/4” Nut driver
Phillips head screw driver
Wiring Diagram

OUTPUT CAPACITOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.14 - OUTPUT CAPACITOR BANK/PRINTED CIRCUIT BOARD LOCATION



1. PC BOARD COVER
2. PC BOARD COVER MOUNTING SCREW (2)
3. PC BOARD MOUNTING SCREW (5)
4. CAPACITOR BANK MOUNTING SCREW (4)
5. VERTICAL BAFFLE
6. CAPACITOR (4)
7. BUSS BAR (2)
8. PC BOARD

PROCEDURE

Before starting the following procedure, refer to the topic “PC Board Troubleshooting Procedures” at the beginning of this section.

1. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bail.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, then reinstall the fuel cap.
5. With the 5/16” nut driver, remove the five screws holding the right case side.
6. Remove the right case side by lifting up and out.
7. Remove the engine spark plug wires.
8. With the 5/16” nut driver, remove the printed circuit board cover. See Figure F.14.

OUTPUT CAPACITOR REMOVAL AND REPLACEMENT *(continued)*

⚠ CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

9. With the 1/4” nut driver, remove the five screws holding the printed circuit board.
10. Carefully pull the printed circuit board aside, supported by the leads still connected to it, so that all the screws that mount the capacitor bank to the vertical baffle are accessible.
11. With the volt/ohmmeter, check the voltage across each of the four output capacitors. If a voltage is present, use a 25-watt resistor to discharge each capacitor.
12. With the 1/2” wrench, remove the two nuts, bolts, and associated washers holding the two heavy leads to the positive and negative capacitor buss bars.
13. With the phillips head screw driver, remove the four mounting screws holding the capacitor bank assembly to the vertical baffle.
14. Carefully remove the capacitor bank assembly.
15. To replace the capacitor bank assembly, mount the assembly to the vertical baffle with four phillips head screws.
16. With the 1/2” wrench, attach the two heavy leads and associated fasteners to the positive and negative buss bars. Observe capacitor polarity.
17. With the 1/4” nut driver, mount the printed circuit board to the vertical baffle (five screws).
18. With the 5/16” nut driver, install the printed circuit board cover.
19. Reinstall the case side, fuel cap, lift bail gasket, and case top.

Return to Section TOC
Return to Master TOC

OUTPUT CONTACTOR REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the output contactor for maintenance or replacement.

MATERIALS NEEDED

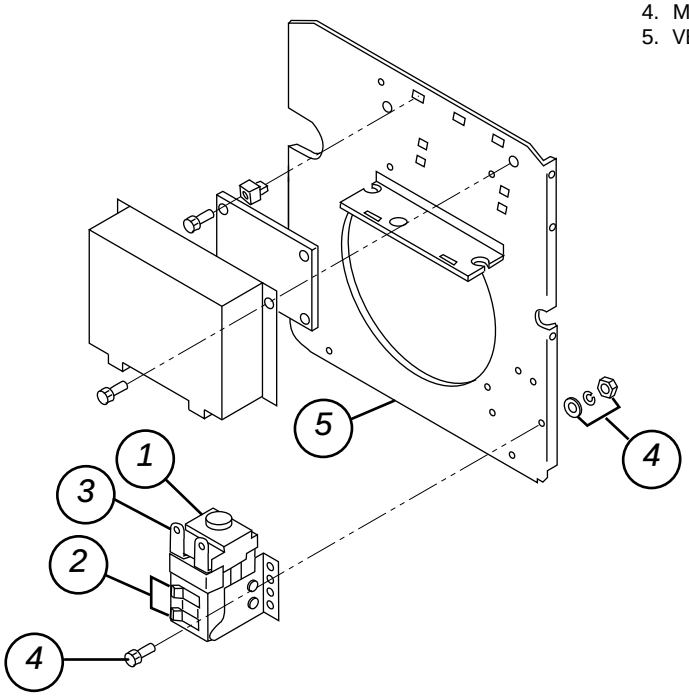
5/16” Nut driver
Needle nose pliers
1/2” Wrench
3/8” Wrench
Slot head screw driver
Wiring Diagram

Return to Section TOC
Return to Master TOC

OUTPUT CONTACTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.15 – OUTPUT CONTACTOR LOCATION

1. CONTACTOR
2. COIL LEAD CONNECTIONS
3. HEAVY LEAD CONNECTIONS
4. MOUNTING HARDWARE (3 SETS)
5. VERTICAL BAFFLE

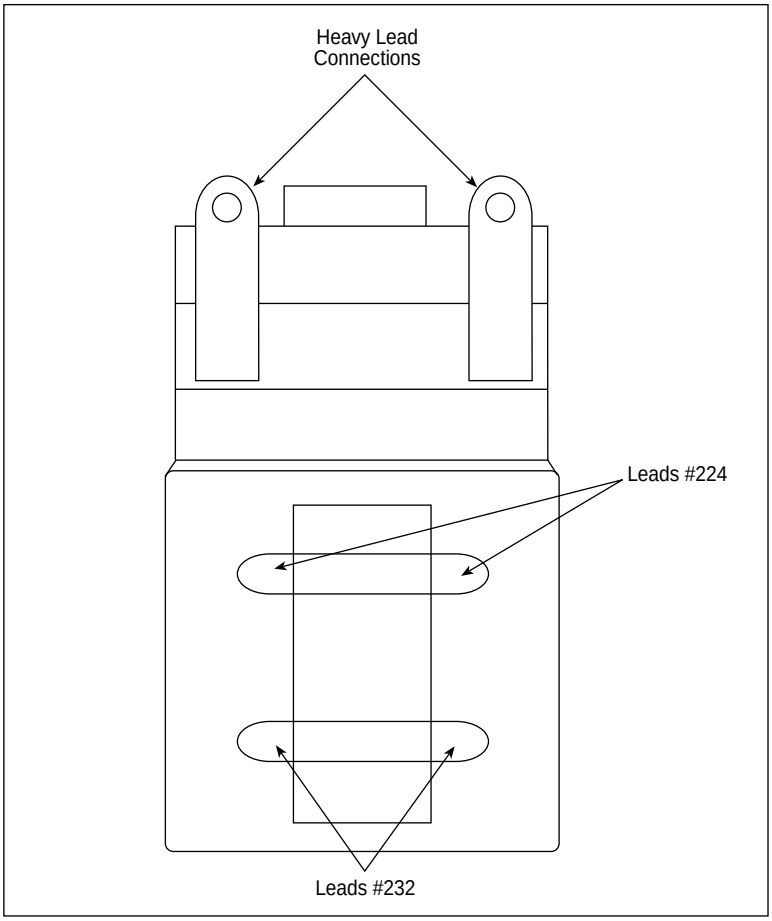


PROCEDURE

1. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bail.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, then reinstall the fuel cap.
5. With the 5/16” nut driver, remove the five screws holding the right case side.
6. Remove the right case side by lifting up and out.
7. Remove the engine spark plug wires.
8. With the needle nose pliers, remove all #232 and #224 leads from the contactor coil. Note placement for reassembly.
9. With the 1/2” wrench, remove the two nuts, bolts, and associated washers holding the two heavy leads to the output contactor.
10. With the slot head screw driver and 3/8” wrench, remove the three mounting screws from the contactor. The contactor can now be removed.
11. To reinstall the output contactor, use the slothead screw driver and 3/8” wrench to attach the three mounting screws that hold the contactor to the vertical baffle.
12. With the 1/2” wrench and the two nuts, bolts, and associated washers, attach the two heavy leads to the output contactor.
13. With the needle nose pliers, carefully attach all #232 and #224 leads to the contactor coil. See the Wiring Diagram and Figure F.16 for lead placement.
14. Reinstall the case side, fuel cap, lift bail gasket, and case top.

OUTPUT CONTACTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.16 – CONTACTOR COIL LEAD PLACEMENT



ENGINE/ROTOR REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing the engine and/or rotor for maintenance or replacement of either component.

MATERIALS NEEDED

Lincoln Electric Rotor Removal Kit (S20788) - FOR ROTOR REMOVAL ONLY

1/4” nut driver
5/16” nut driver
Slot head screw driver
3/8” Wrench
7/16” Wrench
1/2” Wrench
9/16” Wrench
5/8” Wrench
Locking pliers
Needle nose pliers
Diagonal cutters
Impact wrench
Torque wrench (ft lbs)
Feeler gauge (.017)

INSTRUCTIONS

For Engine and Rotor removal only, follow steps 1-25 under ENGINE AND ROTOR REMOVAL PROCEDURE. For reassembly of engine and rotor go to REASSEMBLY PROCEDURE.

For rotor removal, follow the ENGINE AND ROTOR REMOVAL PROCEDURE and ROTOR REMOVAL PROCEDURE.

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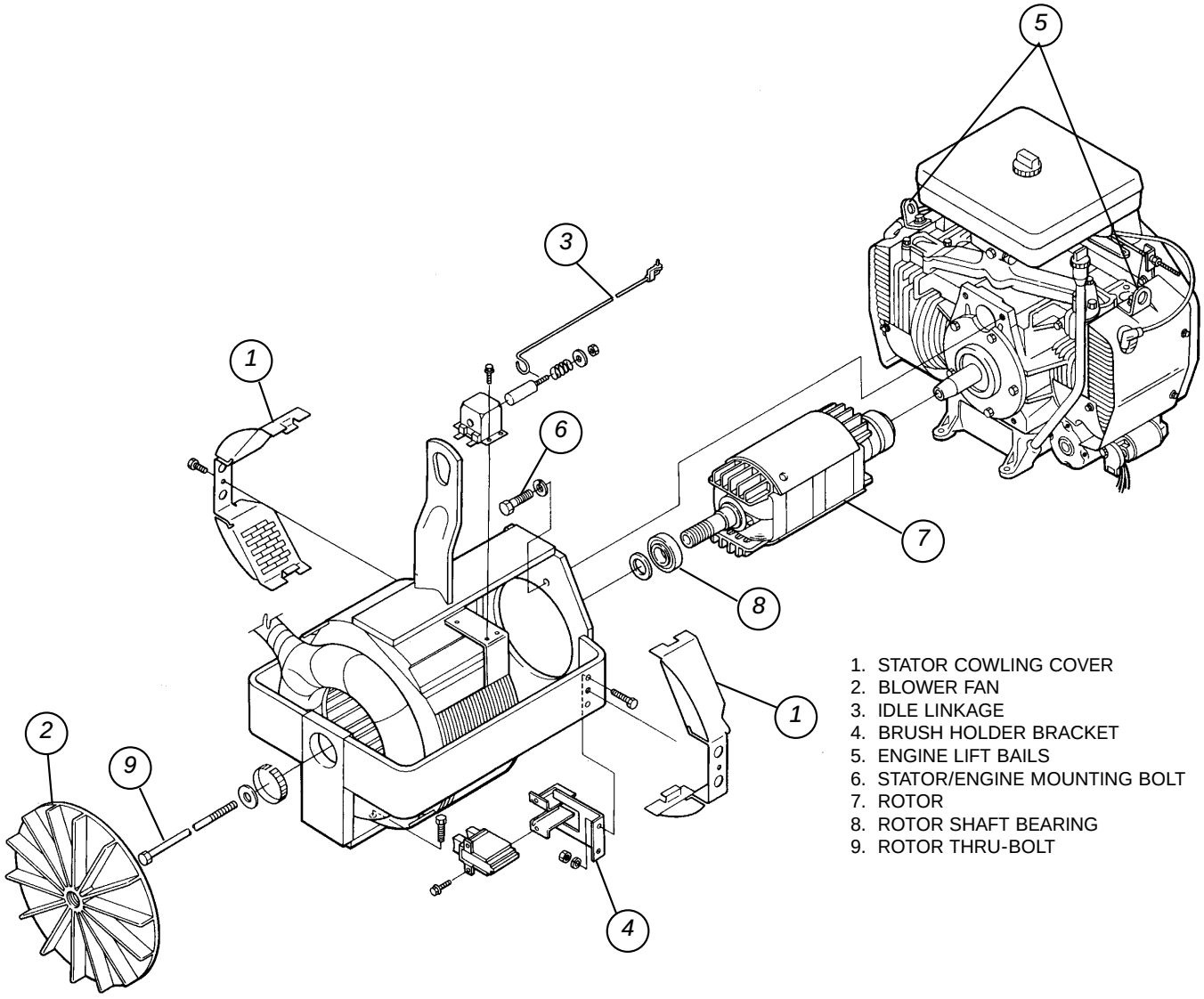
ENGINE/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.17 – COMPONENT LOCATIONS, ENGINE/ROTOR REMOVAL



ENGINE/ROTOR REMOVAL AND REPLACEMENT *(continued)*

ENGINE AND ROTOR REMOVAL PROCEDURE

1. Refer to Figure F.17 for component locations.
2. Remove the engine spark plug wires.
3. With the 5/16” nut driver, remove the 6 sheet metal screws from the case top.
4. Remove the rubber gasket (cover seal) from the lift bale.
5. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
6. Remove the case top, the reinstall the fuel cap.
7. WIth the 5/16” nut driver, remove the 5 screws holding the right case side and the 5 screws holding the left case side.
8. Remove the case sides by lifting up and out.
9. WIth the 3/8” wrench, remove the battery cover.
10. Disconnect the negative battery cable, then the positive battery cable. BE SURE TO DISCONNECT THE NEGATIVE BATTERY CABLE FIRST. Remove the battery and set it aside.
11. With the diagonal cutters, cut the cable ties around the leads from the starter solenoid and disconnect the leads.
12. Disconnect the large black plug in front of the fuel tank spout.
13. With the 3/8” wrench, remove the cowling covers at the rear on the stator, both sides of the machine.
14. WIth the 3/8” wrench, remove the two screws that hold the vertical fan baffle in place. Slide the baffle forward toward the rectifier bridge heat sink assembly.
15. Hold the rotor shaft with locking pliers and unscrew the blower fan. Turn the fan counterclockwise. You do not need to remove the fan from the machine, but be sure it is completely unscrewed from the rotor shaft.
15. With the 5/16” nut driver, disconnect the engine choke cable from the engine. Mark the location of the retainer for reassembly. The other end can remain connected.
16. Disconnect the idle linkage by unsnapping the plastic clip at the engine end of the idler rod. Snap the clip back onto the rod to avoid losing it; remove the rod for reassembly.
17. Disconnect the fuel line from the fuel tank. Plug the hose and also plug the connection at the fuel tank to prevent the escape of gasoline fumes.
18. With the 9/16” wrenches, remove the ground lead from the right engine foot mounting bolt.
19. With the 7/16” wrench, remove the brush holder bracket and leads #219 and #200A from the stator frame.
20. With the 1/2” wrench, remove the muffler suport bolt.
21. Support the engine with a chain hoist. Lift bales are provided on the top of the engine for this purpose.
22. With the 9/16” wrench, remove the right and left engine foot mounting bolts.
23. With the 9/16” wrench, remove the four bolts that hold the stator to the engine. There is one lock washer per bolt.
24. With the chain hoist, unweight the engine gently. Use a pry bar to carefully pry between the engine and the stator frame in order to unseat the bearing on the end of the rotor shaft. Separate the engine and rotor from the stator frame, supporting the rotor by hand to prevent damage to the rotor core.
25. Move the engine and rotor assembly to a bench. The engine is off balance with the rotor still attached; therefore, support the end of the rotor with a wooden two-by-four before unhooking the chain hoist.

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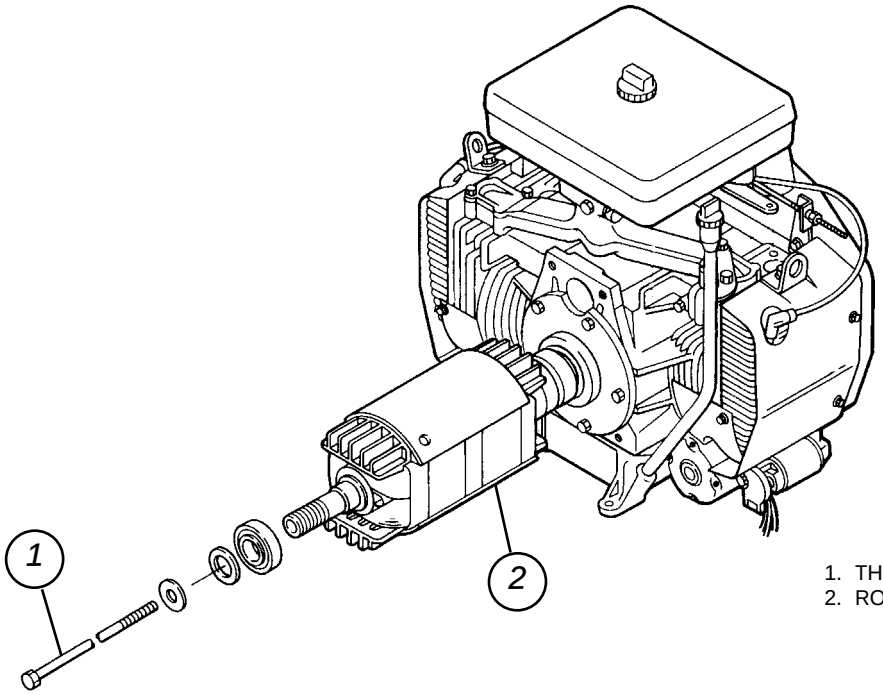
ENGINE/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.18 - ENGINE AND ROTOR REMOVED FROM STATOR



1. THRU-BOLT
2. ROTOR

ROTOR REMOVAL PROCEDURE

1. To remove the rotor, **double check that the engine spark plug wires are disconnected.** You will be turning the rotor during this procedure, and this could accidentally cause engine kickback.
2. With an impact wrench, remove the rotor thru-bolt. See Figure F.18. If an impact wrench is not available, use the 5/8" box wrench. Hold the rotor with one hand and shock the wrench with the mallet to loosen the thru-bolt. The thru-bolt has a star washer and lock washer, beveled to conform to the rotor shaft. Pull out the thru-bolt.
3. Install the appropriate long thru-bolt (two are provided) supplied with Lincoln Electric Rotor Removal Kit S20788. The slot head must face out. Screw in the bolt with the slot head screw driver until the bolt bottoms out on the engine crankshaft, about 3/4".
4. Turning it counterclockwise, screw in the left-hand thread rotor removal tool from the kit into the rotor shaft. Support the rotor with one hand and tighten the tool to approximately 50 ft lbs with the torque or impact wrench.
5. If the rotor does not pop off, tighten the rotor removal tool an additional 5 ft lbs. Hold the rotor with one hand until the rotor pops off the engine crankshaft.

HINT: If the rotor does not pop off, hit the end of the rotor removal tool with a hammer.

6. Slide the rotor the rest of the way off the crankshaft. Be careful not to lose the washer that fits between the blower fan and the rotor.

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ENGINE/ROTOR REMOVAL AND REPLACEMENT (KIT S20788) *(continued)*

REASSEMBLY PROCEDURE

NOTE: Lincoln Electric recommends that a new bearing (Lincoln part #M9300-85) be installed when you replace the rotor and blower assembly.

1. Clean the tapered engine crankshaft. Slide the rotor onto the shaft.
2. Insert the rotor thru-bolt, and with the torque wrench tighten the bolt to 50 ft lbs.
3. Support the engine/rotor assembly with the chain hoist. Fit the rotor into the stator frame, being careful not to damage the rotor core against the stator. The bearing will seat into its race about half way.
4. Insert the four bolts and lock washers that hold the engine to the stator. With the 9/16" wrench, draw the bolts up evenly in order to seat the bearing properly. Tighten to 22 ft-lb. moving diagonally from bolt to bolt.
5. Check the rotor-stator air gap with the .017 feeler gauge. The measurement is taken at the blower end of the rotor before the fan is reinstalled. Turn the rotor with a pair of locking pliers as necessary so that the rotor "iron" is up to take the measurement. (The rotor has two flat sides, which are not measured for air gap.) Slide in the gauge. Then rotate the shaft 180 degrees and measure again. If the gauge does not clear, loosen the four engine/stator bolts; retighten the bolts and recheck the air gap. Repeat until the proper .017 minimum air gap is achieved.
6. Fasten the ground lead to the right engine mounting bolt and install both bolts.
7. Install the brush holder bracket back into the stator frame. Refer to the topic "Brush Removal and Replacement" in this section of the manual.
8. Unplug the fuel tank connection and fuel hose and connect them.
9. Connect the idle linkage to the idler rod. Snap the plastic clip back into place.
10. Connect the engine choke cable at the position marked during disassembly.
11. Screw the blower fan back onto the end of the rotor shaft. Be sure the washer is in place and hand tighten the fan only.
12. Reposition the vertical fan baffle and secure it with the two screws.
13. Install the muffler support hardware.
14. Install the two cowling covers at the rear of the stator.
15. Connect the black plug in front of the fuel tank fill spout.
16. Connect the leads to the starter solenoid and replace any cable ties cut during disassembly.
17. Install the battery. Connect the positive battery cable, then the negative battery cable. BE SURE TO CONNECT THE POSITIVE BATTERY CABLE FIRST.
18. Replace the battery cover.
19. Reinstall the case sides, fuel cap, lift bale gasket, and case top. Connect the spark plug wires.
20. Conduct the "Retest after Repair" procedure, the following topic in this section of the manual.

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RETEST AFTER REPAIR

Retest a machine:

- If it is rejected under test for any reason that requires you to remove any mechanical part which could affect the machine's electrical characteristics. OR
- If you repair or replace any electrical components.

ENGINE OUTPUT

Mode	No Load RPM	Load RPM
Low Idle	2150-2250	NA
High Idle	3700-3750	3100-3650

WELDER DC OUTPUT[1]

Output Control	Range Switch	Open Circuit Volts	Load Volts	Load Amps
Maximum	Maximum	65 - 75	25 - 35	245 - 255

WELDER AC OUTPUT[1]

Output Control	Range Switch	Open Circuit Volts	Load Volts	Load Amps
Maximum	Maximum	73 - 80	25 - 35	250 - 260

WELDER CV OUTPUT[1]

Output Control	Range Switch	Open Circuit Volts	Load Volts	Load Amps
Maximum	Wire Feed CV High	50 - 54	25 - 35	250 - 260
Maximum	Wire Feed CV Med	35 - 38	20 - 24	200 - 240
Maximum	Wire Feed CV Low	34 - 38	16 - 19	155 - 190

AUXILIARY POWER RECEPTACLE OUTPUT[1]

230 Volt Receptacle			115 Volt Receptacle[2]		
Open Circuit Voltage	Load Volts	Load Amps	Open Circuit Voltage	Load Volts	Load Amps
236 - 255	207 - 245	39 - 43	118 - 127.5	103 - 122	78 - 83

AMPHENOL AUXILIARY OUTPUT[1]

42 Volt Auxiliary		115 Volt Receptacle[2]	
Open Circuit Voltage	Load Volts	Open Circuit Voltage	Load Volts
43 - 50	40 - 48	115 - 126	110 - 126

FIELD AMPS AND VOLTS

Slip Ring Volts	Field Amps
40 - 50 VDC	5.2 - 5.8 Amps DC

[1] OUTPUT CONTROL switch set at MAXIMUM (position 10).

[2] Output values of each receptacle can vary within the range shown but must be within 2 volts of each other.

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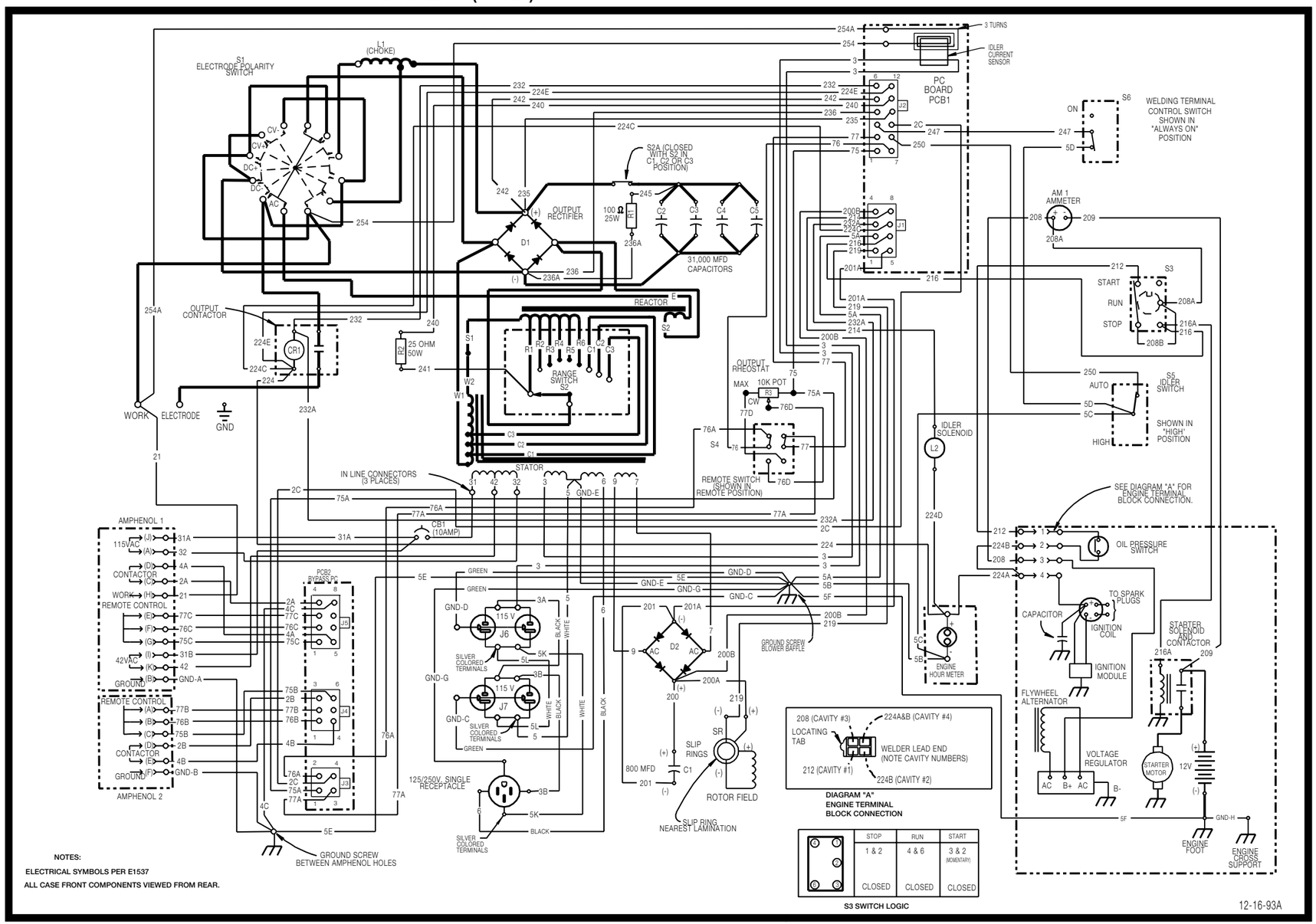
WIRING DIAGRAM RANGER 9 ONAN (CODE 9975)

RANGER 9 (ONAN)



CLEVELAND, OHIO U.S.A.

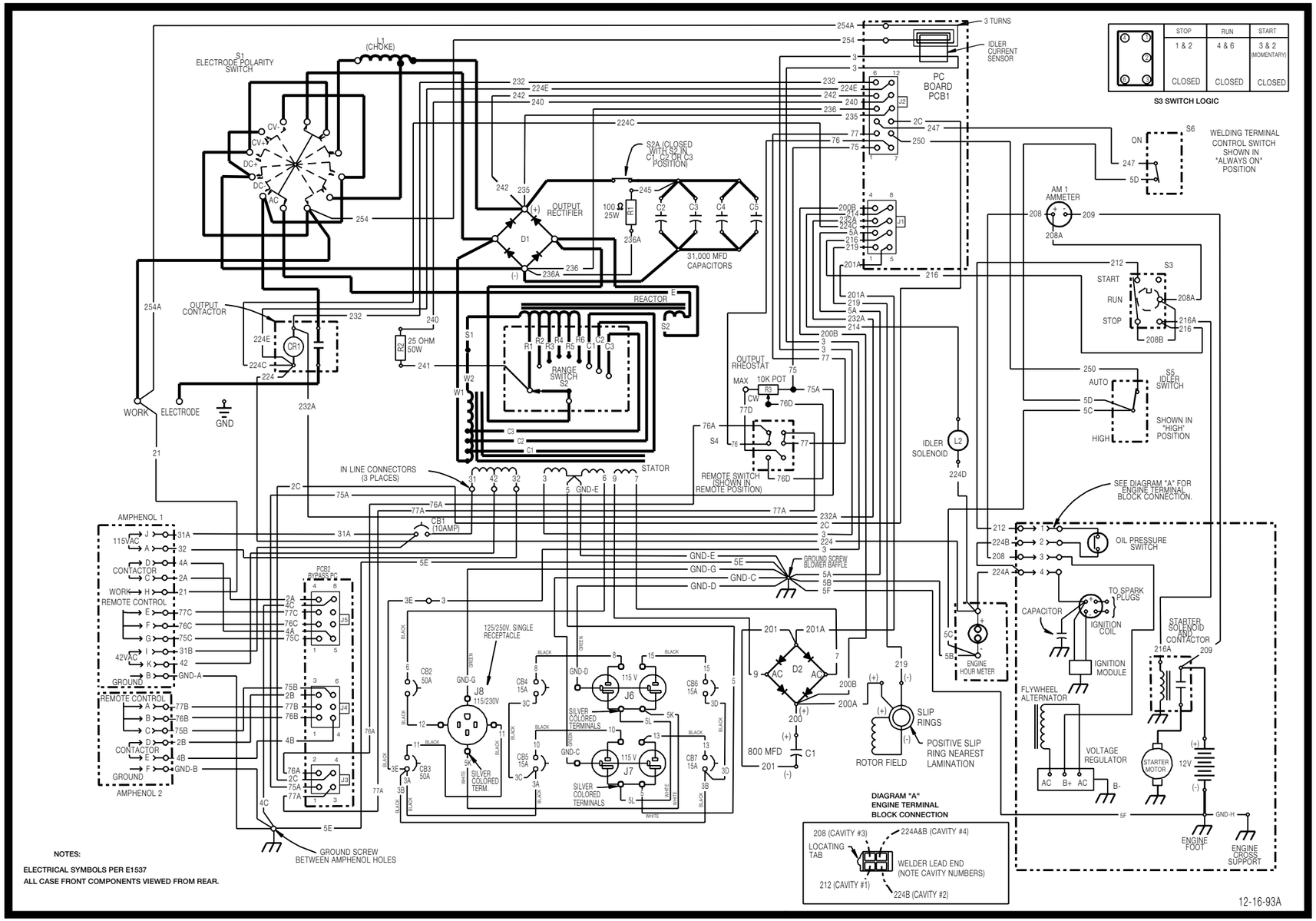
L9112

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels.

DIAGRAMS

WIRING DIAGRAM RANGER 9 ONAN CSA (CODE 9976)

RANGER 9 ONAN (CSA VERSION)

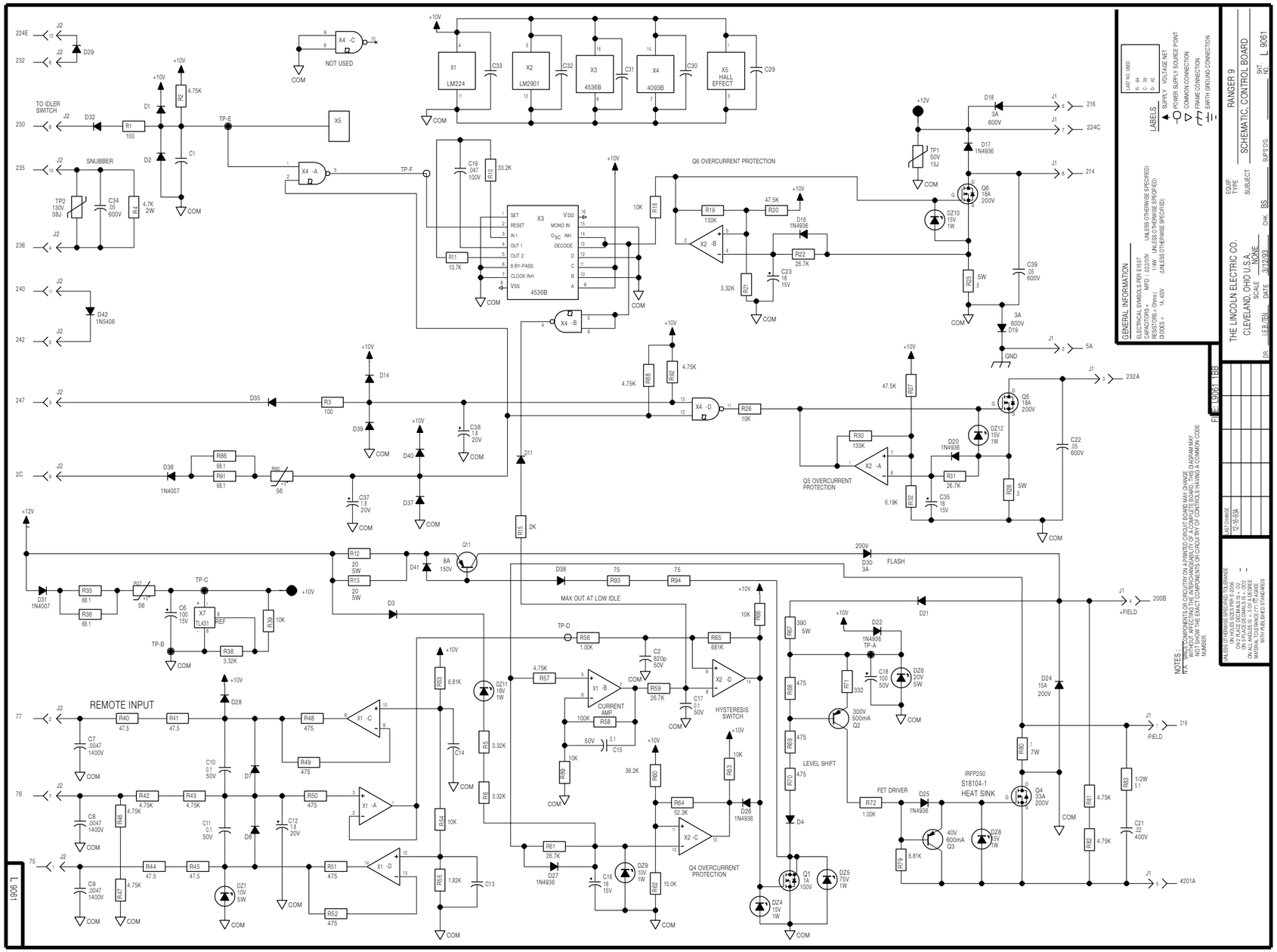


CLEVELAND, OHIO U.S.A. L9113

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels.

DIAGRAMS

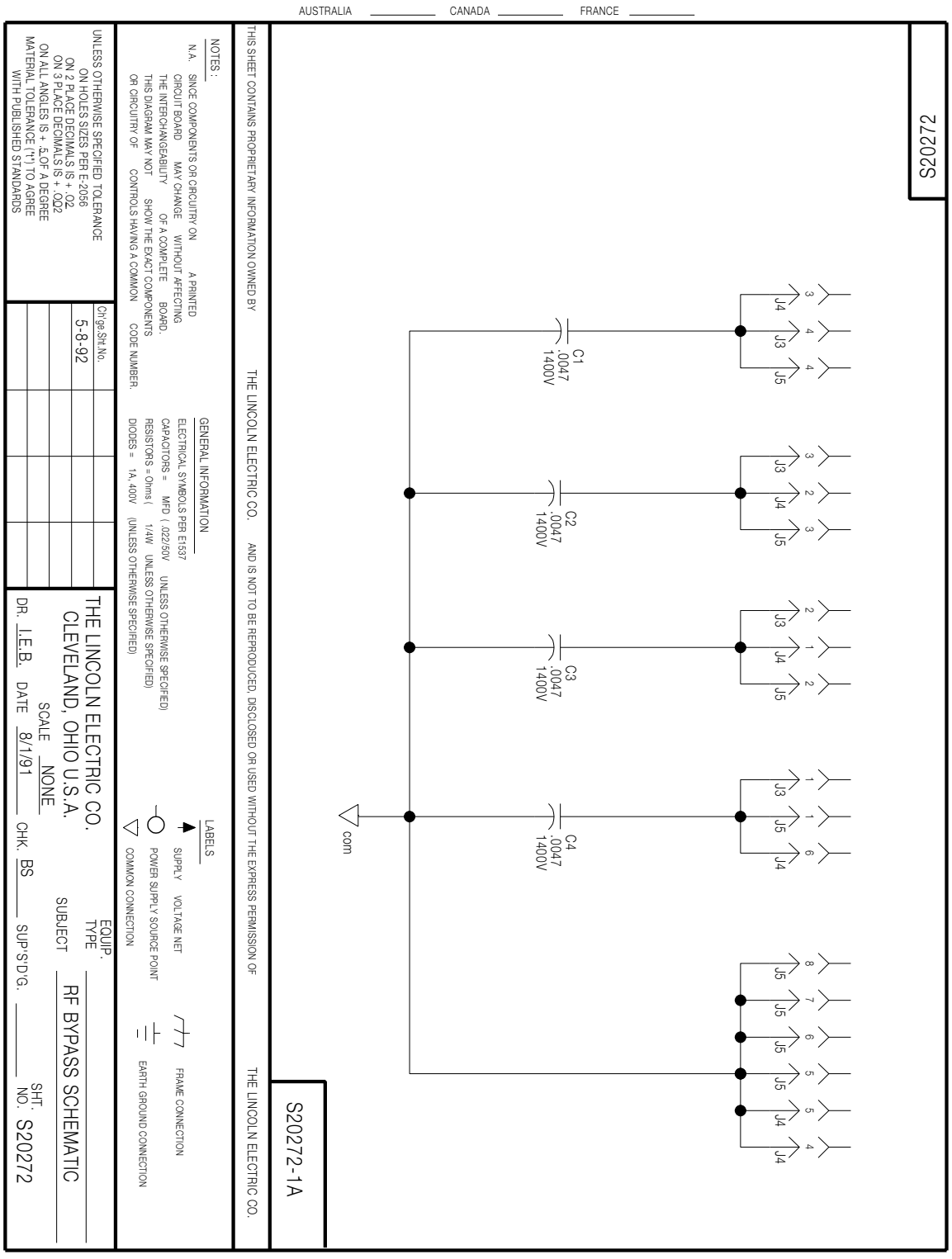
CONTROL PC BOARD (L9062) SCHEMATIC



NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. This Printed Circuit Board schematic is provided for reference only. It may not be totally applicable to your machine's specific PC board version. This diagram is intended to provide general information regarding PC board function. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in Danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.

DIAGRAMS

RF BYPASS PC BOARD (M16675) SCHEMATIC



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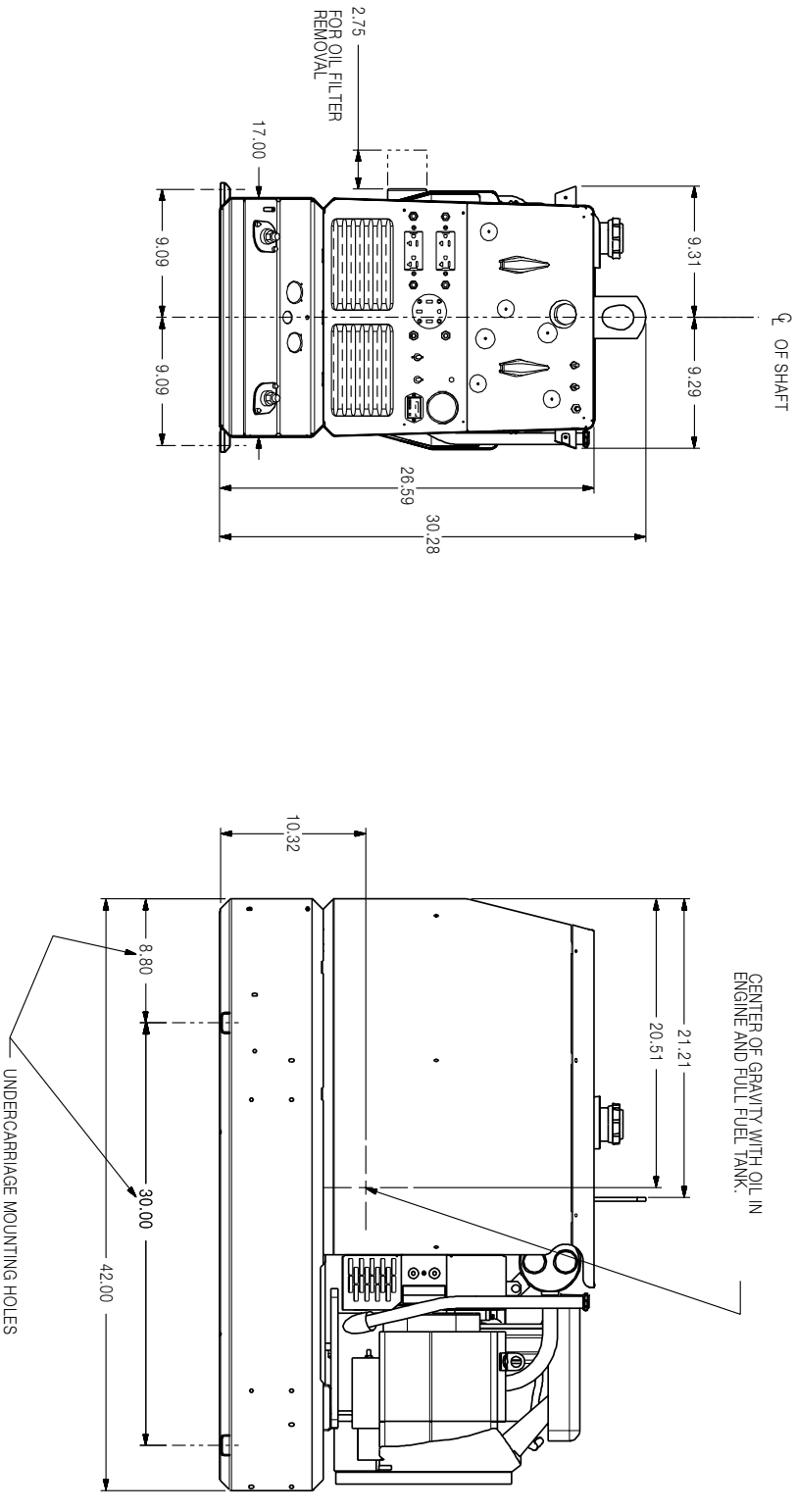
DIAGRAMS

DIMENSION PRINT



RANGER 9 (ONAN)
DIMENSION PRINT
MI7216
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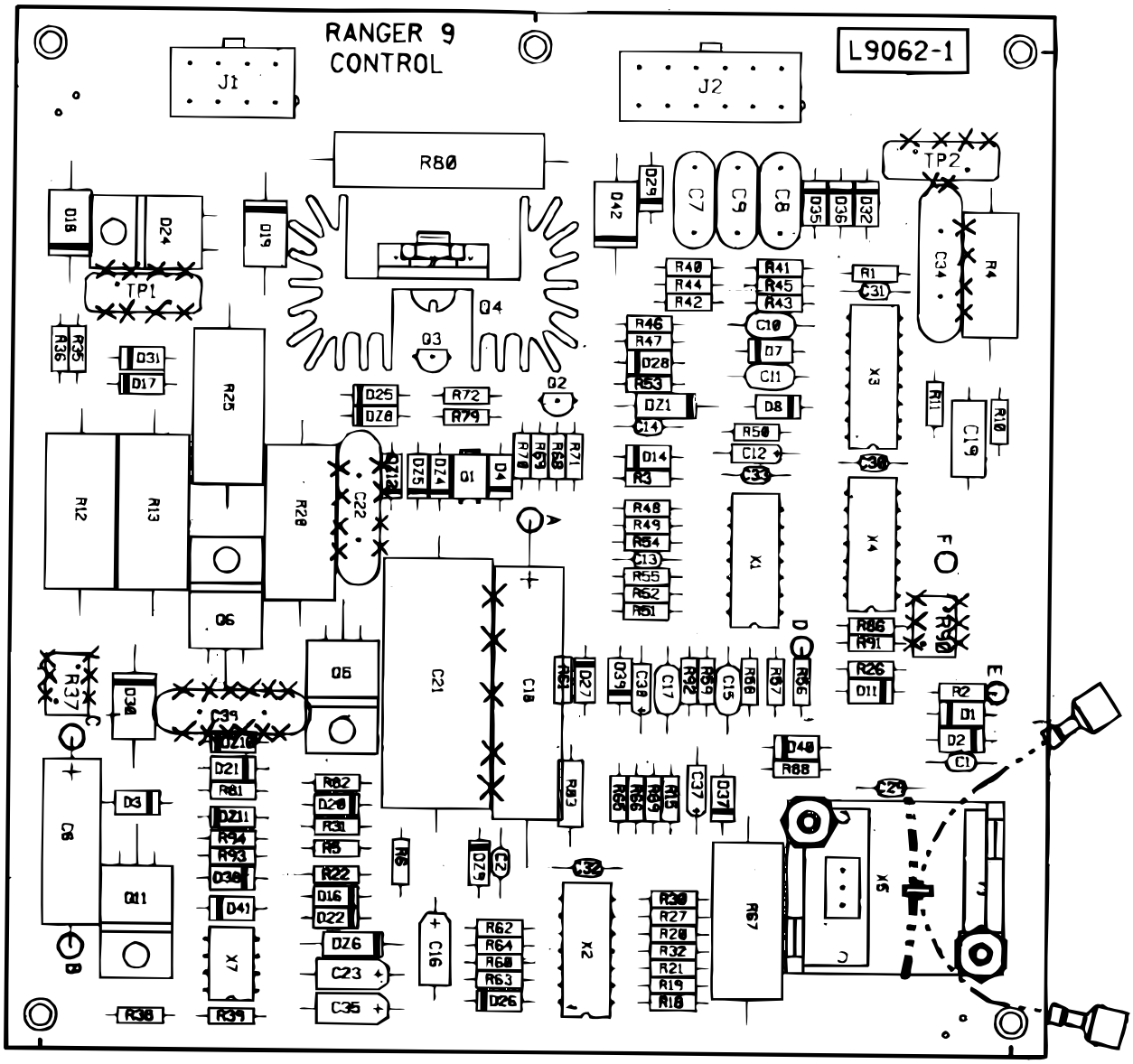
DIAGRAMS

CONTROL PC BOARD (L9062) LAYOUT



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DIAGRAMS

CONTROL PC BOARD (L9062) COMPONENTS

X7	IC-VOLT REF,ADJ,PRECISION,431I
X4	IC-VOLT REG,ADJ,3-T,(+),A
X3	IC-CMOS,TIMER,PROGRAMMABLE,4536
X1	IC-OP-AMP,QUAD,GEN-PURPOSE,224N
TP2	MOV-130VRMS,38J,14MM
TP1	MOV-50VRMS,15J,14MM
R93,R94	RESISTOR-MF,1/4W,75.0,1%
R83	RESISTOR-CC,1/2W,5.1,5%
R71	RESISTOR-MF,1/4W,332,1%
R67	RESISTOR-WW,5W,390,5%,SQ
R65	RESISTOR-MF,1/4W,681K,1%
R64	RESISTOR-MF,1/4W,52.3K,1%
R62	RESISTOR-MF,1/4W,15.0K,1%
R60	RESISTOR-MF,1/4W,39.2K,1%
R58	RESISTOR-MF,1/4W,100K,1%
R56,R72	RESISTOR-MF,1/4W,1.00K,1%
R55	RESISTOR-MF,1/4W,1.82K,1%
R53,R79	RESISTOR-MF,1/4W,6.81K,1%
R69,R70 R48,R49, R50,R51,R52,R68	RESISTOR-MF,1/4W,475,1%
R40,R41,R44,R45	RESISTOR-MF,1/4W,47.5,1%
R37,R90	THERMISTOR-PTC,56 OHMS,90MA
R35,R36,R86,R91	RESISTOR-MF,1/4W,68.1,1%
R32	RESISTOR-MF,1/4W,6.19K,1%
R22,R31,R59,R61	RESISTOR-MF,1/4W,26.7K,1%
R20,R27	RESISTOR-MF,1/4W,47.5K,1%
R19,R30	RESISTOR-MF,1/4W,133K,1%
R89 R18,R26, R39,R54,R63,R66	RESISTOR-MF,1/4W,10.0K,1%
R15	RESISTOR-MF,1/4W,2.00K,1%
R12,R13	RESISTOR-WW,5W,20,5%,SQ
R11	RESISTOR-MF,1/4W,13.7K,1%
R10	RESISTOR-MF,1/4W,33.2K,1%
R5,R6,R21,R38	RESISTOR-MF,1/4W,3.32K,1%
R4	RESISTOR-CC,2W,4.7K,10%
R82,R88,R92 R2,R42, R43,R46,R47,R57,R81	
R1,R3	RESISTOR-MF,1/4W,100,1%
Q5,Q6	TRANSISTOR-NMF,T220,18A,200V,IRF6
Q3	TRANSISTOR-P,T226,0.5A,40V,2N4403
Q2	TRANSISTOR-P,T226,0.5A,300V,MPS-A92
Q1	TRANSISTOR-NMF,4PDIP,1A,100V,RFD110
J2	CONNECTOR,MOLEX,MINI,PCB,12-PIN
J1	CONNECTOR,MOLEX,MINI,PCB,8-PIN
DZ11	ZENER DIODE-1W,18V,5%,1N4746A
DZ9	ZENER DIODE-1W,10V,5%,1N4740A
DZ6	ZENER DIODE-5W,20V,5%,1N5357B
DZ5	ZENER DIODE-1W,75V,5%,1N4761A
DZ4,DZ8, DZ10,DZ12	ZENER DIODE-1W,15V,5%,1N4744A
DZ1	ZENER DIODE-5W,10V,5%,1N5347B
D31,D36	DIODE-AXLDS,1A,1000V
D30	DIODE-AXLDS,3A,200V,1N5402
D24	DIODE-FR,T220,14A,200V,MUR1520
D18,D19,D42	DIODE-AXLDS,3A,600V,1N5406
D16,D17,D20,D22, D25,D26,D27	DIODE-AXLDS,1A,400V,FR,1N4936
D1,D2,D3,D4,D7,D8,D11,D14 D21,D28,D29,D32,D35,D37 D38,D39,D40,D41	DIODE-AXLDS,1A,400V
C22,C34,C39	CAPACITOR-CD,.05,600V,+80/-20%
C19	CAPACITOR-PEMF,.047,100V,10%
C18	CAPACITOR-ALEL,100,50V,+75/-10%
C16,C23,C35	CAPACITOR-TAEL,18,15V,10%
C12,C37,C38	CAPACITOR-TAEL,1.8,20V,10%
C10,C11,C15,C17	CAPACITOR-CEMO,0.1,50V,10%
C7,C8,C9	CAPACITOR-CD,.0047/.005,1400V,20%
C6	CAPACITOR-ALEL,100,15/16V,+75/-10%
C2	CAPACITOR-CEMO,820P,50V,5%
C1,C13,C14, C29,C30,C31,C32 C33	CAPACITOR-CEMO,.022,50V,20%

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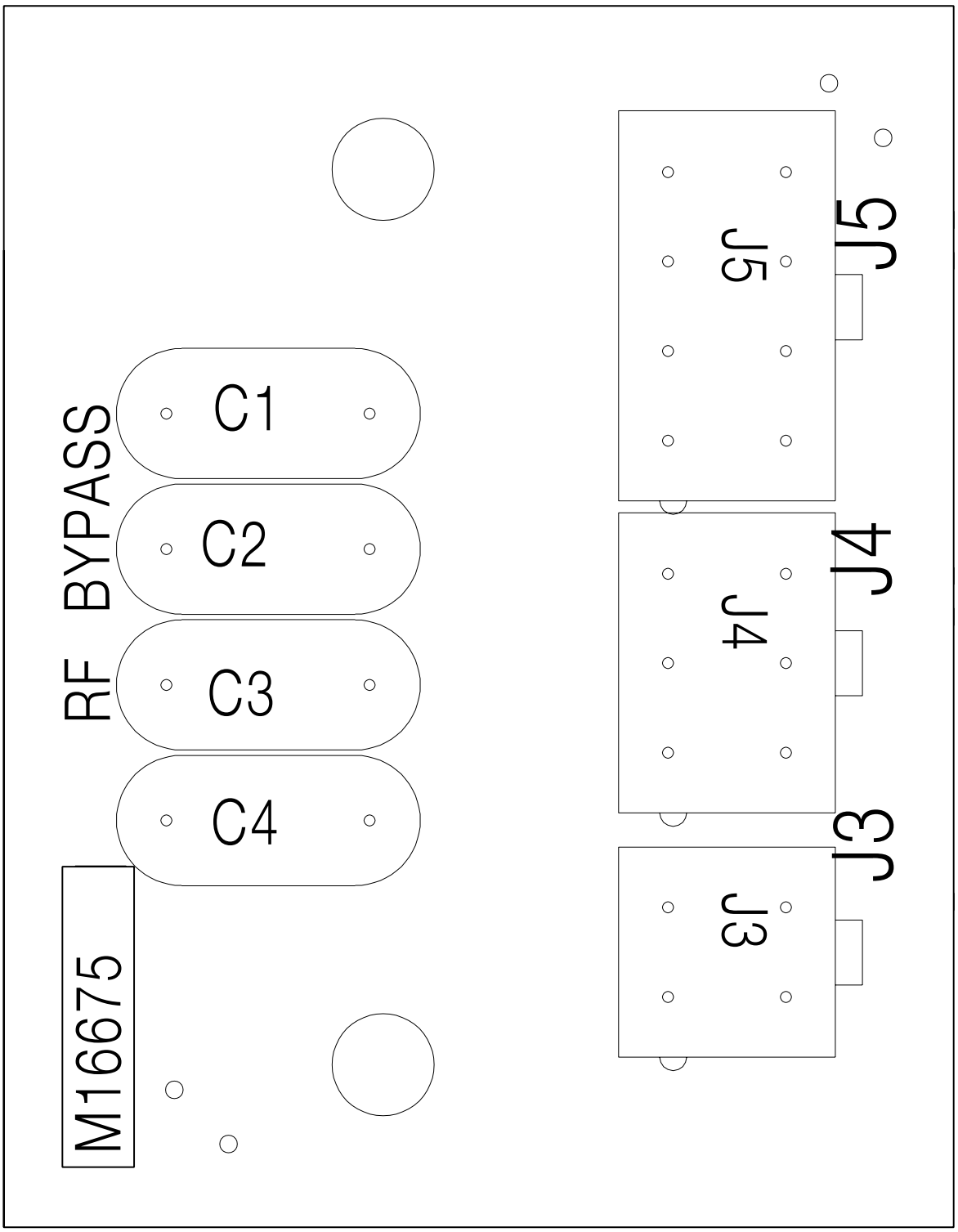
DIAGRAMS

RF-BYPASS PC BOARD (M16675) LAYOUT



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DIAGRAMS

RF-BYPASS PC BOARD (M16675) COMPONENTS

Item	Description
J3	CONNECTOR,MOLEX,MINI,PCB,4-PIN
J4	CONNECTOR,MOLEX,MINI,PCB,6-PIN
J5	CONNECTOR,MOLEX,MINI,PCB,8-PIN
C1,C2,C3,C4	CAPACITOR-CD,.0047/.005,1400V,20%

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